

DISGUST AND RELIGIOUS MORALITY OF MIND

BY

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DISSERTATION

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ABSTRACT

Religious thoughts and beliefs are often perceived to have drastic moral consequences (e.g., faith in God leading to eternal life). At the same time, religions often emphasize the avoidance of physical and spiritual contamination. Whereas past research has found that people experience disgust in response to immoral behaviors (e.g., sibling incest, eating rotten meat, and unfairness), here I investigate the nature of disgust in response to religious thought violations. Can mere thoughts—independent of behavior—elicit disgust and feelings of contamination? In Study 1, thinking about religious statements perceived as false (e.g., “praying to God is a waste of time”) elicited more self-reported disgust and more harsh moral judgments than factually false statements (e.g., “there are 13 letters in the English alphabet”). Moreover, self-reported disgust predicted more harsh moral judgments after statistically controlling for the influence of anger and other negative emotions. Study 2 directly replicated the effects of Study 1, and also found that contamination partially mediated the association between disgust and moral judgments. Studies 3 and 4 used facial electromyography (EMG) to address a more fundamental question: is disgust in response to religious thought violations associated with physical disgust (i.e., oral/nasal inhibition)? Study 3 first replicated previous research demonstrating an association (a) between self-reported disgust, physical contamination (e.g., “eating in a dirty public bathroom”), and levator labii muscle activity, and (b) between self-reported anger, harm violations (e.g., “someone kicking your pet dog”), and corrugator supercilii muscle activity. In Study 4, although self-report measures again replicated Studies 1 and 2, there was no evidence that religious thought violations were associated with physical disgust as measured by levator labii muscle activity. Instead, self-reported disgust (along with other negative emotions) was associated with corrugator supercilii muscle activity. This suggests that while physical and moral disgust may

share in common subjective feelings of contamination, religious thought violations do not elicit the same facial muscle activity as physically contaminating stimuli. Blasphemous thoughts may be perceived as disgusting/contaminating, but only metaphorically so.

To Amber, Anderson, Landon, and Leo

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CHAPTER 1: INTRODUCTION

Many people consider their religious beliefs—mere thoughts entertained in the privacy of their own mind—to have drastic moral consequences. Consider atheism. In this case someone simply endorses the idea that God does not exist. According to the law of the land there is no wrongdoing here. There is no action to be held accountable for. But for many religious believers this idea is considered blasphemy and punishable by an eternity in hellfire. It is a sin that causes spiritual harm and impacts the destiny of the soul in the afterlife. This makes sinful thoughts far more consequential than any possible earthly punishment for actually committing an unlawful crime. After all, eternal damnation is far worse than a few years in prison or even physical death. And the moral consequence of beliefs is not just limited to eternal punishment. For the religious, their beliefs (e.g., faith in God) can also lead to eternal rewards. This perception of extreme consequences for unobservable thoughts and beliefs suggests that the content of the mind is an important domain of morality.

Of course religions also attempt to regulate people's actual behavior. Some behaviors are explicitly prohibited (e.g., killing, lying, and adultery) while others are encouraged. Yet at times more emphasis is placed on the content of the mind than the product of actions:

You have heard that it was said to the people long ago, “Do not murder,” and “anyone who murders will be subject to judgment.” But I tell you that anyone who is angry with his brother will be subject to judgment... You have heard that it was said, “Do not commit adultery.” But I tell you that anyone who looks at a woman lustfully has already committed adultery with her in his heart. (Matthew 5:21-22, 27-28; New International Version)

In other words, even *thinking* about killing someone or having sex with someone who is not your spouse is wrong and subject to moral judgment. And whereas these are examples of forbidden

thoughts about forbidden actions, beliefs about the supernatural are perceived to carry moral consequences as well. Most people think that belief in God is a pre-requisite for morality (Pew Research Center, 2014), and the prevalence of religious beliefs suggests that most people are concerned with the moral consequences of their own thoughts: 74% of Americans believe in God, 64% believe in the survival of the soul after death, 68% believe in heaven, and 58% believe in hell (The Harris Poll, 2013).

Yet despite this anecdotal evidence that thoughts and beliefs can play an important role in people's moral lives, the vast majority of past research on morality in social psychological science has focused on behaviors (for a review, see Chapman & Anderson, 2013). The purpose of the present research is twofold. First, I aim to extend beyond a morality of behaviors to a *morality of mind* by explicitly investigating how people respond to perceived religious thought violations. Specifically, due to religions' emphasis on the pursuit of physical and spiritual cleanliness and the avoidance of contamination (Preston & Ritter, 2012; Ritter & Preston, 2011), I examine the hypothesis that religious thought violations are perceived as disgusting/contaminating. Moral violations are often described as disgusting, and this includes both physical/sexual (e.g., incest) and social (e.g., unfairness) taboos. But because these are all moral violations that involve overt action, it is unclear whether immoral *thoughts* are also perceived as disgusting. Moreover, although people describe both physical and social taboos as disgusting, it is unclear exactly what this means. If people report being disgusted by certain moral violations, does this mean that they are literally nauseous and in a state of oral/nasal inhibition? Some previous research suggests that both physical/sexual and social taboos trigger a more primitive disgust mechanism that evolved for the purpose of avoiding physical contamination (e.g., food toxins; Chapman, Kim, Susskind, & Anderson, 2009). Yet others

argue that “disgust” in response to social taboos is a metaphor (Royzman & Kurzban, 2011; Royzman & Sabini, 2001). After all, one of the concrete concepts that people often rely on to understand the abstract concept of morality is cleanliness (i.e., morality is “clean”, immorality is “dirty”; for a review, see Landau, Meier, & Keefer, 2010). This would suggest that although physical/sexual taboos and social taboos can both activate conceptual knowledge about contamination, it does not mean that disgust is always used to communicate a physical state of nausea and oral/nasal inhibition. Instead, concrete conceptual knowledge about contamination could simply be used to give meaning to abstract thoughts. Given this debate, the second aim of this research is to investigate whether disgust in the context of religious thought violations is literal/physical (i.e., associated with oral/nasal inhibition) or metaphorical in nature. I do this by examining whether physical contaminants (e.g., vomit) and religious thought violations both elicit facial muscle activity consistent with an oral/nasal inhibition response. If they do, then this would provide further evidence that social taboos—moral violations that have nothing to do with physical contamination—elicit physical disgust. If not (and yet people still report being “disgusted” by religious thought violations), then this would provide evidence that people are using conceptual knowledge about (un)cleanliness as a metaphor for immorality, but not that they are physically disgusted.

In sum, this research will address two primary questions: (1) are religious thought violations associated with disgust/contamination?; and (2) does the evidence better support the hypothesis that disgust in response to religious thought violations is physical (i.e., associated with oral/nasal inhibition) or metaphorical? Throughout I pay special attention to the association between disgust and anger, the latter being another emotion that has been strongly implicated in response to social taboos.

CHAPTER 2: RELIGIOUS MORALITY OF MIND

Is it possible for an abstract thought—mental activity that ostensibly poses no threat of physical contamination—to elicit disgust? I argue that the answer is yes, particularly in the domain of religion. Religious traditions tend to rely heavily on the concept of cleanliness to guide both the behaviors and thoughts of adherents (Graham & Haidt, 2010). Whether it is rules related to food practices and preparation (Johnson, White, Boyd, & Cohen 2011) or symbolic purification rituals (e.g., ablution, baptism), religions emphasize the pursuit of both physical and spiritual cleanliness. Indeed previous research has found evidence that religious concepts activate concepts of cleanliness, and making people feel clean increases subjective feelings of religiosity (Preston & Ritter, 2012). Importantly, the pursuit of physical and spiritual cleanliness also implies the avoidance of physical and spiritual contamination. And insofar as proscribed religious thoughts are perceived as a source of spiritual contamination, they should elicit disgust despite posing no threat to the physical body.

There is evidence to suggest that proscribed religious thoughts are indeed perceived as a source of spiritual contamination, capable of leaving a “stain” on one’s moral character. Consider the pervasive belief in an immaterial soul that is separate from the physical body (Bering, 2006; Bering & Bjorklund, 2004)—so called “common sense dualism” (Bloom, 2004, 2007). Religious believers must monitor the content of their mind because thoughts and beliefs (e.g., faith in God) are perceived to influence the fate of the soul in the afterlife. They are encouraged to hold fast to “purity” and “virtue,” and avoid “sin” and “immorality.” Otherwise, God will know. After all, God is perceived as the ultimate moral agent capable of rewarding virtue and punishing iniquity (Gray, Gray, & Wegner, 2007), and with omniscience comes privileged access even to unobservable thoughts (Bering & Johnson, 2005; Boyer, 2001).

Moreover, religious beliefs are used as a heuristic for judging moral character (Norenzayan & Shariff, 2008), such that disbelief in God is associated with immorality. Atheists are perceived as less trustworthy than the religious people (Gervais, Shariff, & Norenzayan, 2011), and all throughout Africa, Asia, and the Middle East, an overwhelming majority thinks that faith in God is a pre-requisite for morality (e.g., 95% in Egypt). Fifty-three percent of Americans also agree (Pew Research Center, 2014). Religious scriptures only reinforce the idea that thoughts and beliefs speak to the content of moral character: “The fool says in his heart, ‘There is no God.’ They are corrupt, their deeds are vile; there is no one who does good” (Psalm 14:1; New International Version). Note that people who believe that “rocky road is the best ice cream” are not similarly characterized as corrupt and vile. In other words, facts and preferences are not *moralized* (Rozin, 1999), and religious beliefs are not perceived as preferences but as sacred values (Heiphetz, Spelke, Harris, & Banaji, 2013; Tetlock, Kristel, Elson, Green, & Lerner, 2000). It is not morally wrong to think that “chicken of the sea” tuna is actually chicken, or to enjoy anchovies on your pizza. But religious thoughts and beliefs are sanctified and help establish and maintain membership within a larger cultural and moral community (Graham & Haidt, 2010). This means that people who do not hold ingroup religious beliefs and values are often perceived as “contaminated” and avoided (Cottrell & Neuberg, 2005).

There is also experimental evidence supporting the idea that proscribed religious thoughts are perceived as contaminating (Ritter & Preston, 2011). In one study, I asked Christian undergraduates to read and write a passage from either Richard Dawkins’ (2006) *The God Delusion*, The Qur’an, or the dictionary. All participants were asked to taste and rate a drink before and after writing the passage, ostensibly as part of an unrelated study. Participants rated the second drink to be more disgusting than the first after writing a passage from *The God*

Delusion or The Qur'an, but there was no such effect for participants asked to write a passage from the dictionary. In a second study using a similar design, Christian undergraduates were asked to read and write a passage from either *The God Delusion*, The Qur'an, or The Bible. Further, half of the participants were asked to wash their hands with an antiseptic wipe after writing the passage, whereas the other half were asked to simply look at the cleaning wipe. Consistent with the first study, participants who did not wash their hands rated the second drink to be more disgusting than the first after contact with *The God Delusion* or The Qur'an, but not The Bible. Participants who were allowed to wash their hands after writing the Qur'an or God Delusion passage did not show any increase in disgust. In both studies, the effects remained after controlling for general feelings of negative affect, suggesting that copying an outgroup religious passage was associated with the subjective feelings of contamination.

Other researchers have also studied the morality of thought content, but have not specifically investigated the role of disgust. Phillip Tetlock and colleagues (Tetlock et al., 2000; Tetlock, 2003) have found that people respond with moral outrage (i.e., anger, contempt, and disgust) and engage in what the authors call "moral cleansing" (i.e., seek to reaffirm solidarity with one's own moral community) in response to threats to sacred values. In one study (Tetlock et al., 2000; Study 5), for example, participants were asked to consider counterfactual scenarios about Jesus' life (e.g., "If Jesus had not chosen Judas as one of his 12 disciples, Jesus would not have been betrayed or crucified") as well as secular counterfactuals. Christian fundamentalists were more likely to respond to the religious counterfactuals with negative affect (including disgust) and "moral cleansing" (i.e., increased intentions to expand involvement in church activities over the next year). In a related set of studies, Cohen and Rozin (2001) found that Protestants were more likely than Jews to negatively evaluate a target person with inappropriate

mental states (e.g., thinking about a sexual affair). Protestants were thus much more likely to moralize their thoughts, and rated thoughts as being more controllable and likely to lead to action than Jewish participants (Cohen, 2003; Cohen & Rozin, 2001). And in more recent research, the suppression of forbidden thoughts, emotions, and impulses lead to greater creative work in the lab for Protestants (but not for Catholics or Jews), further evidence of the influence of religious culture on how people process their own thoughts (Kim, Zeppenfeld, & Cohen, 2013). Finally, Sam Harris and colleagues have also investigated the neural correlates of believing and disbelieving information (Harris et al., 2009; Harris, Sheth, & Cohen, 2008). Participants in one study were asked to read and rate whether they believed a series of statements to be true, false, or undecidable while in an fMRI scanner. The statements came from one of five different domains (e.g., mathematical: $(2 + 6) + 8 = 16$ "; geographical: "Wisconsin is on the west coast of the United States"; religious: "A personal God exists, just as the Bible describes"). Their findings suggest that disbelief—compared to belief—is associated with increased activity in (among other areas) the anterior insula, which has been previously implicated in the experience of disgust and distaste (Harris et al., 2008).

Although each of these studies speaks to the morality of thought content, one of the primary aims of the present research is to investigate a more specific hypothesis: that religious thought violations are perceived as disgusting/contaminating. My own previous research is consistent with this hypothesis (Ritter & Preston, 2011), but because the dependent variable involved subjective perceptions of a beverage it did not adequately investigate the potential influence of other negative emotions. Also consistent with the present hypothesis, Tetlock and colleagues propose a sacred value protection model that

predicts a "mere contemplation effect" [such that] it is not necessary to commit a

counternormative act; it is sufficient for counternormative thoughts to flicker briefly through consciousness prior to rejecting them. That brief prerejection interval, during which our natural first reaction to propositions is apparently to consent (Gilbert, 1991), can produce a subjective sense—however unjustified—that one has been cognitively contaminated and has fallen from moral grace in the community. (Tetlock et al., 2000, p. 855)

But recall that these researchers measured relatively undifferentiated feelings of “moral outrage” and “moral cleansing.” There was no explicit investigation of cognitive contamination that also accounted for the influence of other negative moral emotions. In other words, their findings could have been driven by general negative affect rather than subjective feelings of contamination specifically. A similar problem arises in the interpretation of Harris and colleagues’ fMRI studies demonstrating that disbelief (compared to belief) is associated with increased blood flow to the anterior insula (Harris et al., 2008). Although insula activation was associated with disgust, activity in this area cannot be interpreted as a reliable marker of disgust because it is also implicated in other negative affective experiences including anger, anxiety, and physical pain (Chapman & Anderson, 2013; Lindquist, Wager, Kober, Bliss-Moreau, & Barrett, 2012). Harris and colleagues (2008) also made no distinction between religious/ethical statements and factual statements (e.g., about geography and math), and instead investigated belief vs. disbelief more generally.

The present research addresses these limitations by measuring people’s subjective emotional experience in response to factual or religious ideas perceived as true or false, and investigates the unique influence of each emotion on subsequent moral judgments of those thoughts (i.e., how morally wrong the thought is perceived to be). If feelings of

disgust/contamination are uniquely involved in the perception of religious thought violations, then disgust should predict subsequent moral judgments even after statistically controlling for other negative emotional experiences. On the other hand, if disgust/contamination does not predict moral judgments after controlling for other emotional experiences, then this would suggest that religious thought violations are more strongly associated with another negative emotion or more generally with negative affect.

CHAPTER 3: DISGUST

The previous chapter provided reasons (and some experimental evidence) to suggest that religious thought violations can elicit feelings of disgust/contamination, and briefly outlined some predictions if this is true. But I have not yet addressed the question of the *nature* of disgust. If people report being disgusted by the mere contemplation of certain ideas, does this mean that they are experiencing physical disgust (e.g., nausea and oral/nasal inhibition) or is “disgust” used metaphorically? Can moral disgust be distinguished from other negative emotions like anger? These questions have been controversial, with researchers finding evidence to support different positions.

There is broad agreement that disgust evolved to motivate the avoidance of physical contamination. Specifically, disgust is thought to have originated in the avoidance of bitter or toxic foods (Chapman et al., 2009; Rozin & Fallon, 1987), and evolved as part of a “behavioral immune system” to promote withdrawal from bodily products, open wounds, illness, and other potentially harmful sources of infection (Schaller & Park, 2011). The prototypical disgust expression—characterized by a wrinkling of the nose and an opened mouth (Ekman & Friesen, 1975)—plays an adaptive role by preventing the inhalation of odors and promoting food expulsion (Rozin & Fallon, 1987; Shariff & Tracy, 2011). Put simply, disgust is believed to be a disease avoidance mechanism (Oaten, Stevenson, & Case, 2009). But beyond the consensus that disgust is associated with the avoidance of physical contamination, researchers disagree on the role that disgust plays in the moral domain.

Moral Disgust as an Elaboration of Physical Disgust

One of the most influential theories of the association between disgust and morality is based on the work of Paul Rozin and colleagues. These researchers emphasize the role of both

biological and cultural evolution in the expansion of disgust from protecting the body to protecting the “soul” (Rozin, Haidt, & McCauley, 1999, 2008). From this perspective disgust elicitors are categorized into four distinct domains: core disgust, animal-nature disgust, interpersonal disgust, and moral disgust. Core disgust functions to protect the body from physical contaminants such as human and animal body products (e.g., feces, vomit, urine, and blood). Animal-nature disgust is related to inappropriate sexual acts, poor hygiene, death, and bodily envelope violations (e.g., gore, deformity, obesity). Interpersonal disgust functions to prevent contact with unknown or undesirable persons, including those who may be diseased or morally tainted (e.g., convicted child molesters). Finally, moral disgust is elicited in response to violations that do not involve the physical body such as hypocrisy, betrayal, and racism. Together, these four categories constitute so-called “purity” violations. And critically, each of these categories of purity violations is thought to trigger the same disgust mechanism and its corresponding outputs (e.g., physiology, behavior, and facial expression) that have remained relatively unchanged throughout evolutionary history. Through preadaptation—the process of an existing system being co-opted for a new purpose—the biologically based disgust mechanism is thought to be utilized as a signal of an ever expanding set of purity violations.

This perspective on disgust has helped pave the way for researchers to move beyond so-called “moral monism” (Graham et al., in press) accounts that describe morality as being reducible to concerns about a single value or virtue, such as justice (Kohlberg, 1969). Specifically, the role of disgust has been emphasized in several recent pluralistic accounts which suggest that morality can be divided into three (Rozin, Lowery, Imada, & Haidt, 1999; Shweder, Much, Mahapatra, & Park, 1997), four (Rai & Fiske, 2011), five (Graham et al., 2011; Haidt & Joseph, 2007), or even six or more distinct domains (Graham et al., in press; Haidt, 2012). The

CAD triad hypothesis, for example, posits that violations of three moral codes (community, autonomy, and divinity) map onto the three other-condemning moral emotions (contempt, anger, and disgust; Rozin et al., 1999). Moral foundations theory similarly emphasizes concerns for purity as one of five distinct moral domains that is rooted in concerns about disease and contamination (Haidt & Joseph, 2007) (for a modern criticism of moral pluralism, see Gray, Schein, & Ward, in press; Gray, Young, & Waytz, 2012).

Other researchers agree that an innate disgust mechanism is triggered in response to a variety of elicitors, but argue that purity violations should instead be categorized according to their functional role in solving specific adaptive problems faced by our ancestors (Tybur, Lieberman, & Griskevicius, 2009; Tybur, Lieberman, Kurzban, & DeScioli, 2013). From this perspective disgust functions (a) to avoid pathogens, (b) to avoid low quality or low compatibility sexual partners, and (c) to avoid people who engage in non-normative/anti-social behaviors that threaten one's social group. People who were better able to detect and respond to risks associated with these three categories were more likely to survive and reproduce, making biological evolution the driving force behind the evolution of disgust (cf. Rozin & Haidt, 2013).

Inspired by these theoretical accounts, a considerable amount of experimental research has investigated the hypothesis that moral violations are associated with physical disgust (for a review, see Chapman & Anderson, 2013). For example, manipulating disgust by having participants drink an unpleasant beverage (Eskine, Kacinik, & Prinz, 2011), watch a disgusting film clip (Horberg, Oveis, Keltner, & Cohen, 2009), or smell fart spray (Schnall, Haidt, Clore, & Jordan, 2008) all increase the severity of subsequent moral judgments relative to control conditions. And critical for the present research, some of the most convincing evidence that moral violations can elicit physical disgust comes from a series of studies showing increased

activation of the levator labii facial muscle (which wrinkles the nose and raises the upper lip and is theorized to be related to the older system used to prevent the ingestion/inhalation of hazardous substances) in response to bitter tastes, disgusting photographs, and increasingly unfair offers in an ultimatum game (Chapman et al., 2009).

Alternative Perspectives

But this dominant interpretation that moral disgust is an expansion of physical disgust has not gone unchallenged. Other researchers have argued that “the common usage of the word ‘disgust’ in moral contexts should not seduce us into believing that, in the cases like these, the feelings on the response side are anything like the feelings one is surely plunged into through an encounter with feces, slime, and severed limbs” (Royzman & Sabini, 2001, p. 53). In other words, moral transgressions may not elicit physical disgust at all. Instead, describing these acts as “disgusting” may be used as a metaphor to make abstract concepts about immorality more concrete (Royzman & Kurzban, 2011; Royzman & Sabini, 2001). This is consistent with the finding that cleanliness is but one of many metaphors that people may use to understand abstract moral concepts. For example, morality/immorality has also been associated with brightness/darkness (Sherman & Clore, 2009) and high/low vertical positions (Meier, Sellbom, & Wygant, 2007).

Another strong criticism of the argument that moral disgust elicits physical disgust is that moral disgust is often indistinguishable from anger. Specifically, disgust in response to social taboos is strongly co-activated with anger, and once anger is accounted for the effect of disgust is typically greatly reduced if not completely eliminated (for a review, see Russell & Giner-Sorolla, 2013). This has led some to suggest that disgust is simply used as a synonym for anger (Nabi, 2002), or that disgust is “disguised” in the moral emotion of indignation (i.e., anger; Moll et al.,

2005). In studies comparing emotional responses to both physical disgust elicitors (e.g., dog feces, vomit) and socio-moral taboos (e.g., betrayal, racism), researchers have consistently found that physical and moral disgust are associated with distinct emotional profiles. Whereas physical stimuli elicit disgust alone, social taboos tend to be associated more generally with negative affect (e.g., also eliciting anger and sadness; Marzillier & Davey, 2005; Simpson, Carter, Anthony, & Overton, 2006). These findings are also consistent with fMRI studies showing that the processing of physical disgust and moral disgust are associated with distinct yet partially overlapping neural substrates (Moll et al., 2005; Schaich Borg, Lieberman, & Kiehl, 2008).

Findings such as these have led the association between disgust and morality to be questioned on other grounds. The dominant view that moral disgust as an expansion of physical disgust is based on the view that disgust is an innate and discrete emotion (Ekman, 1992; Ekman & Cordaro, 2011) with a universally recognized facial expression (Ekman, 1994a; Ekman, Sorenson, & Friesen, 1969; Haidt & Keltner, 1999; Keltner & Ekman, 2000) and distinct physiological signature (Ekman, Levenson, & Friesen, 1983; Levenson, Ekman, & Friesen, 1990). However an alternative perspective argues that emotions are not innate and distinct “natural kinds” (Barrett, 2006a), and that the subjective experience of emotion (including the experience we label “disgust”) is better understood as a conceptualization of more basic psychological “ingredients” (Barret, 2006b; Lindquist, 2013). From this perspective there is no innate disgust mechanism in the brain that triggers a specific coordinated set of outcomes (Barrett, 2011; Russell, 1994). Instead, discrete emotional experiences are constructed when the experience of core affect—general feelings of pleasure/displeasure and activity/inactivity—is made meaningful by conceptual knowledge of the specific situation. In the case of disgust, this

constructionist perspective of emotions suggests that the concept of disgust is acquired over time through experience and cultural knowledge about contamination.

Support for this hypothesis comes from studies demonstrating that children do not even begin to reliably recognize the prototypical disgust expression as disgust until age 9 (Widen & Russell, 2013), and kids under 8 are perfectly happy to consume a beverage that has recently had a contaminant removed (e.g., a fly; Rozin, Fallon, & Augustoni-Ziskind, 1986). Even feces can be a source of fun and games for young toddlers (Rozin, Hammer, Oster, Horowitz, & Marmora, 1986). These findings are not what would be expected if disgust is an innate psychological mechanism that evolved for the purpose of disease avoidance (Rottman, in press). Adults, on the other hand, are extremely hesitant of once-contaminated beverages, or foods that merely resemble something foul (Rozin, Millman, & Nemeroff, 1986). This suggests that people *learn* the things they should be disgusted by (Bloom, 2004; Rozin & Fallon, 1987). Complicating things further, disgust is notoriously difficult to reliably distinguish from other negative high arousal emotions (such as anger) based on peripheral physiology, facial muscle activity, or brain activity (Cacioppo, Berntson, Larsen, Poehlmann, & Ito, 2000). And if disgust is not an innate discrete emotion then this calls into question any unique association between disgust and morality (Cameron, Lindquist, & Gray, under review). For example, one series of studies recently found that any emotion that elicits general arousal—including disgust, but not uniquely disgust—increased the subsequent severity of moral judgments (Cheng, Ottati, & Price, 2013).

In sum, there are at least two questions that remain a matter of debate. Does moral disgust elicit a more primitive physical disgust mechanism (i.e., oral/nasal inhibition)? And can moral disgust be distinguished from anger? Religious thought violations represent an ideal context to study these questions because, unlike concrete contaminants (e.g., feces, corpses) and

sexual behaviors (e.g., incest), they pose no ostensible threat to the physical body. In other words, religious thought violations should elicit disgust as well as other negative emotions such as anger, consistent with previous research examining physical vs. moral disgust (Marzillier & Davey, 2005; Russell & Giner-Sorolla, 2013; Simpson et al., 2006). However here I argue that moral disgust can be distinguished from anger, at least in part because disgust (but not anger) is associated with subjective feelings of contamination and “uncleanliness.” If moral disgust is better understood as a synonym for anger (e.g., Moll et al., 2005; Nabi, 2002), then self-reported disgust should provide no additional ability to predict moral judgments after statistically controlling for anger, and disgust should not be uniquely associated with contamination. Moreover, if it is true that disgust is associated with thought violations because of religions’ emphasis on physical and spiritual “cleanliness”, then religiosity may moderate the effect of disgust on moral judgments. In other words, I also examine whether people that are more religious—and have thus been more exposed to cultural knowledge that some thoughts can be contaminating—report stronger disgust in response to religious thought violations.

Finally, I address the question of the literal/physical vs. metaphorical nature of moral disgust by comparing facial muscle activity in response to concrete contaminants (e.g., vomit) vs. religious thought violations. Specifically, if concrete contaminants and religious thought violations both elicit muscle activity consistent with an oral/nasal inhibition response, then this would provide evidence that moral disgust is literally an expansion of physical disgust (Chapman et al., 2009). But previous research using EMG to study facial muscle activity in response to moral violations has been limited in two important ways. First, although Chapman and colleagues (2009) convincingly demonstrated that levator labii activity is associated with distaste, physically contaminating stimuli, and unfairness, they only measured levator labii facial

muscle activity. In other words, their methodology leaves open the possibility that unfair offers may have been more strongly associated with another facial muscle had it been measured (e.g., the corrugator supercilii muscle which is more generally related to negative affect; Cacioppo et al., 2000). Other research has measured more than one facial muscle (Cannon, Schnall, & White, 2011), but seven out of the ten “purity” violations in their research involved the physical body (e.g., injecting drugs into body with a syringe, getting a surgery that splits tongue in two, rarely showering and smelling bad). Only two scenarios represented non-bodily violations (writing “666” in hymnals and Bibles in church pews, and signing a piece of paper to sell one’s soul). And because these bodily and non-bodily purity violations were analyzed together it is unclear what the physiological correlates of non-bodily violations may be. In the present research I measure both levator labii and corrugator supercilii facial muscle activity in response to both physical contaminants and religious thought violations. By examining self-reported emotional experience together with facial muscle activity, I aim to get a better understanding of the nature of moral disgust and its association with anger.

CHAPTER 4: OVERVIEW OF THE PRESENT RESEARCH

The present research set out to investigate two primary questions. First, are religious thought violations associated with disgust/contamination? I argue that the answer is yes, namely because religions tend to emphasize the avoidance of both physical and spiritual contamination. If this concern for “cleanliness” also extends to thoughts and beliefs, then religious thought violations should be associated with disgust. Yet despite anecdotal evidence that thoughts and beliefs play an important role in people’s moral lives, no research has directly investigated the hypothesis that disgust plays an important role in the morality of mind. In fact, past research has focused almost exclusively on the morality of overt *behaviors* (e.g., Cannon et al., 2011; Chapman et al., 2009; Danovitch & Bloom, 2009; Eskine et al., 2011; Graham et al., 2011; Gutierrez, Giner-Sorolla, & Vasiljevic, 2012; Haidt, Koller, & Dias, 1993; Harlé & Sanfey, 2010; Helzer & Pizarro, 2011; Horberg et al., 2009; Hutcherson & Gross, 2011; Jones & Fitness, 2008; Moll et al., 2005; Moretti, & di Pellegrino, 2010; Nabi, 2002; Parkinson et al., 2011; Rozin et al., 1999; Schaich Borg et al., 2008; Schnall, Benton, & Harvey, 2008; Schnall et al., 2008; Simpson et al., 2006; Taylor, 2007; Ugazio, Lamm, & Singer, 2012; Wheatley & Haidt, 2005; Young & Saxe, 2011; Zhong & Liljenquist, 2006; Zhong, Strejcek, & Sivanathan, 2010). Here I expand the moral domain to include the *morality of mind* by investigating people’s emotional responses to religious thought violations. Specifically, I measure self-reported disgust along with other negative emotions (e.g., anger) to assess the unique effect of feelings of contamination on subsequent moral judgments

The second question addressed by the present research is whether the evidence better supports the hypothesis that disgust in response to religious thought violations is physical (i.e., associated with oral/nasal inhibition) or metaphorical. Researchers continue to debate this issue

(e.g., Chapman & Anderson, 2011; Royzman & Kurzban, 2011). Here I investigate this question by examining the physiological correlates of self-reported disgust using facial electromyography (EMG). If moral disgust elicits physical disgust, then religious thought violations and physical disgust elicitors should elicit similar facial muscle activity (i.e., muscle activity consistent with oral/nasal inhibition). On the other hand, if religious thought violations and physical disgust elicitors activate different patterns of facial muscle activity (and yet people still report that both are “disgusting”), then this would provide evidence for the view that moral disgust is metaphorical and has nothing to do with oral inhibition.

Throughout the studies I make a distinction between factual and religious ideas. If religious ideology (but not facts or preferences) is moralized, then thinking about ingroup religious beliefs (but not mundane factually true thoughts) should make people feel pure and virtuous; whereas thinking about ideas that threaten one’s religious ingroup (but not mundane factually false thoughts) should make people feel disgusted. The blasphemous thoughts should not only be perceived as false, but also morally wrong, and elicit a subjective feeling of contamination. Thus in all studies, participants are presented with a series of statements that are either factually true (e.g., “the earth orbits around the sun”), factually false (e.g., “the earth’s moon is made out of cheese), or religious (e.g., “God does not exist”). The factual statements are meant to be objectively true or false, and are included to rule out the possibility that cognitive contamination is experienced in response to *any* kind of incorrect information as a means of rejection. In contrast, there are no objectively right or wrong answers concerning the religious statements, which contain elements of both fact and preference (Heiphetz et al., 2013). I thus expect considerable variability in the extent to which participants reject or endorse the religious

statements. Participants are asked to self-report their emotional experience as they consider each statement in their mind, and rate how morally wrong they perceive each statement to be.

Across studies I investigate the following hypotheses:

Hypothesis 1: Religious statements perceived as false will elicit more harsh moral judgments than factually false statements.

Hypothesis 2: Religious statements perceived as false will elicit more self-reported disgust than factually false statements.

Hypothesis 3: Self-reported disgust will predict more harsh moral judgments of the statements, and this effect will remain after controlling for other negative emotional responses such as anger.

Hypothesis 4: Disgust (but not anger) is associated with feelings of contamination, and contamination will mediate the association between disgust and moral judgments.

Finally, as described above, in Studies 3 and 4 I also examine the physiological correlates of self-reported disgust using facial electromyography (EMG). By taking self-reported measures of emotional experience together with facial muscle activity, I aim to understand the nature of moral disgust and how it is associated with anger.

CHAPTER 5: STUDY 1

Study 1 was designed to address whether disgust is elicited by religious thought violations. Participants were randomly assigned to think about one of sixteen statements—eight factual and eight religious—and self-report their emotional experience (anger, disgust, fear, sadness, surprise, and happiness) using Likert scales. Whether the statement was perceived as true or false and the extent to which it was perceived as immoral were also measured using semantic differential scales.

Method

Participants

Three hundred people were recruited online from the United States through Amazon's Mechanical Turk. TurkGate version 0.4.0 (Goldin & Darlow, 2013) was used to maintain a database of each unique participant and prevent participation in future related studies. As described in detail below, thirty-four participants were excluded for having a completely neutral attitude toward the statement they were assigned to read. This left 266 people (151 men, 115 women; mean age = 32.24 years, $SD = 11.50$) included in the analyses. Self-reported religious affiliations included 73 Atheists, 64 Agnostics, 47 Protestants, 37 Catholics, 37 "Other", 7 Muslims, 5 Buddhists, 4 Jews, and 1 Hindu.

Procedure

The Mechanical Turk HIT (Human Intelligence Task) was titled "Information Survey (~5 minutes)" and included a short description specifying that the study involved thinking about a statement and answering some questions about it. Participation was limited to people located in the United States and whose overall Mechanical Turk approval rate was greater than or equal to 75 percent. The study was divided into three main parts.

Part 1: Emotional Experience. After accepting the HIT and providing informed consent, everyone read the following instructions: “In the first part of the survey we are interested in the emotions you experience as you read a statement that will appear on the next page. We ask that you please read the statement carefully and pay close attention to any emotion(s) you experience as you read it. Whenever you are ready, click the next button to begin.” Participants were then randomly assigned to see one of sixteen statements, of which eight were factual statements and eight were religious. Among the eight factual statements, four were objectively true (e.g., “The earth orbits around the sun”) and four were objectively false (e.g., “The earth’s moon is made out of cheese”). Among the eight religious statements, four supported a traditional Christian religious belief (e.g., “Jesus is the way, the truth, and the life”) and four supported an alternative religious belief (e.g., “Praying to God is a waste of time”; see Table 5.1 for complete list of statements). Seven point scales were used to indicate how much, if at all, they experienced each of six emotions as they considered the statement: disgust, anger, fear/anxiety, sadness, surprise, and happiness/joy (1 = *not felt at all*; 7 = *very strongly felt*). The six emotion scales appeared on a single page in a different randomized order for each participant.

Part 2: Evaluations. In the second part of the survey everyone read the following instructions: “Next, please use the scales provided below to indicate how you feel about the statement you just read. There are no right or wrong answers—please make your ratings based on your own personal beliefs.” Evaluations were made using 7-point semantic differential scales. Moral judgment was measured using three scales: immoral-moral, wicked-virtuous, and good-bad. Veracity was measured using two scales: true-false and acceptable-unacceptable. Each point on the scales was labeled “extremely”, “quite”, “slightly”, or “neutral” (e.g.,

extremely immoral to *extremely moral*), and all five semantic differential scales appeared on a single page in a different randomized order for each participant.

Part 3: Demographics. Finally, everyone completed a four item measure of religiosity (i.e., “I consider myself a religious person”, “I believe in God”, “My personal religious beliefs are important to me”, and “If someone wanted to understand who I am as a person, my religion or faith would be very important in that”) using 7-point scales (1 = *disagree strongly*; 7 = *agree strongly*), and reported their political identity (1 = *extremely liberal*; 7 = *extremely conservative*), age, sex, ethnicity, first language, and religious affiliation (*Atheist, Agnostic, Buddhist, Christian [Catholic], Christian [Protestant], Hindu, Jewish, Muslim, and/or Other [please specify]*). More than one religious affiliation could be selected if desired.

Results

R version 3.0.3 (R Core Team, 2014) was used for all statistical analyses in this and all remaining studies. R code and data files for all studies are available upon request.

Preparing Data for Analysis

Two of the three moral judgment items (immoral-moral and wicked-virtuous) were reverse scored so that higher values indicated more harsh moral judgment, and the mean of the three items was computed to create a composite moral judgment score (Cronbach’s alpha = .86). The mean of the two veracity items was computed to create a composite measure of veracity (Cronbach’s alpha = .94). Because participants may vary in perceptions of the veracity of each statement, a dichotomous Veracity variable was created by coding values greater than 4 as false, and values less than 4 as true. Participants (n = 34) with a completely neutral attitude (i.e., a mean of exactly 4 on the Veracity scale) were excluded from the analysis. The mean of the four religiosity items was computed to create a composite religiosity score (Cronbach’s alpha = .93).

Moral Judgments

Table 5.1 displays the mean moral judgment rating for each statement, broken down by whether the statement was perceived as true or false. I first tested the prediction that religious statements perceived as false would elicit more harsh moral judgments than the factually false statements. Moral judgment scores were regressed onto variables representing Veracity (True = -0.5, False = 0.5), Statement Type (Factual = -0.5, Religious = 0.5), and their interaction. The main effect of Statement Type was estimated to be 0.11 (95% CI [-0.16, 0.38], $t(262) = 0.81$, $p = .42$), indicating no meaningful difference in moral judgments between Factual and Ideological statements overall. However, the mean difference in moral judgments between True and False statements was estimated to be 1.97 (95% CI [1.70, 2.24], $t(262) = 14.52$, $p < .001$), and this main effect of Veracity was qualified by a Statement Type x Veracity interaction ($\beta = 1.15$, 95% CI [0.62, 1.69], $t(262) = 4.24$, $p < .001$)¹. As displayed in Figure 5.1, the Religious False statements were perceived to be more immoral than the Factual False statements (Hedges's $g = .64$, 95% CI [0.30, 0.98]), and the Religious True statements were perceived to be more moral than Factual True statements (Hedges's $g = .40$, 95% CI [0.05, 0.76]).

Sex (men = -0.05, women = 0.5), mean-centered political identity, and mean-centered religiosity were also entered into separate regression models along with Veracity and Statement Type to investigate any moderating effects of these variables. There were no statistically significant main effects or interactions with participant sex, and there was a Veracity x Political Identity interaction ($\beta = 0.19$, 95% CI [0.02, 0.36], $t(258) = 2.22$, $p = .03$). There was also a Veracity x Religiosity interaction ($\beta = 0.30$, 95% CI [0.18, 0.42], $t(258) = 4.85$, $p < .001$). Most importantly, the 3-way Veracity x Statement Type x Religiosity interaction was estimated to be

¹ The main effect of Veracity ($\beta = 0.46$, 95% CI [0.41, 0.51], $t(262) = 18.86$, $p < .001$) and the Statement Type x Veracity interaction ($\beta = 0.39$, 95% CI [0.29, 0.48], $t(262) = 7.88$, $p < .001$) were also statistically significant when Veracity was entered as a (mean-centered) continuous variable.

0.35 (95% CI [0.11, 0.60], $t(258) = 2.84, p < .01$), indicating that moral judgments of the Religious False statements were more harsh among more religious participants.

Disgust

Next I tested whether the Religious False statements elicited more self-reported disgust than the Factual False statements. As in the previous analysis, disgust scores were regressed onto variables representing Veracity, Statement Type, and their interaction. The main effect of Statement Type was estimated to be 1.03 (95% CI [0.64, 1.42], $t(262) = 5.22, p < .001$), indicating that the Religious statements elicited more disgust than the Factual statements overall. The main effect of Veracity was estimated to be 1.86 (95% CI [1.47, 2.25], $t(262) = 9.42, p < .001$), indicating that the False statements elicited more disgust than the True statements overall. As expected, these main effects were qualified by a Statement Type x Veracity interaction ($\beta = 1.13$, 95% CI [0.35, 1.91], $t(262) = 2.86, p = .005$)². As seen in the left side of Figure 5.2, this interaction was driven primarily by the Religious False statements eliciting more self-reported disgust than the Factual False statements (Hedges's $g = .77$, 95% CI [0.43, 1.12]).

Sex, mean-centered political identity, and mean-centered religiosity were again entered into separate regression models along with Veracity and Statement Type to investigate any moderating effects of these variables on self-reported disgust. There were no statistically significant main effects or interactions with participant sex or political identity, but the 3-way Veracity x Statement Type x Religiosity interaction was estimated to be 0.42 (95% CI [0.06, 0.78], $t(267) = 2.3, p = .02$) indicating that self-reported disgust toward the Religious False statements was particularly strong among the relatively more religious participants.

² The main effects of Statement Type ($\beta = 0.96$, 95% CI [0.59, 1.33], $t(262) = 5.05, p < .001$), Veracity ($\beta = 0.43$, 95% CI [0.35, 0.51], $t(262) = 10.98, p < .001$), and the Statement Type x Veracity interaction ($\beta = 0.34$, 95% CI [0.19, 0.49], $t(262) = 4.35, p < .001$) were also statistically significant when Veracity was entered as a (mean-centered) continuous variable.

Anger

Effects on self-reported anger were similar to disgust (see Figure 5.2). The main effect of Statement Type was estimated to be 0.93 (95% CI [0.54, 1.31], $t(262) = 4.77, p < .001$), the main effect of Veracity was estimated to be 1.73 (95% CI [1.35, 2.11], $t(262) = 8.92, p < .001$), and the Statement Type x Veracity interaction was estimated to be 1.14 (95% CI [0.38, 1.91], $t(262) = 2.95, p < .01$). The moderating effect of religiosity was estimated to be 0.35 (95% CI [-.01, 0.72], $t(258) = 1.91, p = .06$), and participant sex nor political identity moderated the Statement Type x Veracity interaction. Figure 5.2 also displays the mean emotional experience by Statement Type and Veracity for self-reported fear, sadness, surprise, and happiness.

Predicting Moral Judgments

Finally I investigated whether self-reported disgust would predict more harsh moral judgment, and if so, whether this effect would remain even after controlling for other emotional experiences. To address this question I used two approaches. First, I computed Pearson zero-order and partial correlation coefficients among the composite moral judgment score and self-reported emotional experience. Second, given the hierarchical structure of the data (i.e., participants nested within one of sixteen statements) and the fact that the statements used in Study 1 represent a sample of a broader population of possible statements, I also used linear mixed effects models (lme4 package in R; Bates, Maechler, Bolker, & Walker, 2014) to appropriately model the statement factor as a random effect.

Correlations. As seen in the lower diagonal of Table 5.2, the zero-order correlation coefficients revealed a strong association between moral judgment and all of the self-reported emotions. However, the partial correlation coefficients in the upper diagonal of Table 5.2 reveal

that only disgust ($r = .15$), surprise ($r = .17$), and happiness ($r = -.51$) remained significantly associated with moral judgment after controlling for the effects of all other emotions.

Mixed Effects Models. As recommended by Judd, Westfall, and Kenny (2012) all mixed effects models reported throughout this paper used restricted maximum likelihood estimation and Kenward-Roger approximation for degrees of freedom, and both stimuli (statements) and the disgust slope were modeled as random effects. Unless specified otherwise, all predictor variables were grand mean-centered.

Consistent with the zero-order correlation approach above, when moral judgment scores were regressed onto self-reported disgust alone the effect was estimated to be 0.42 (95% CI [0.31, 0.54], $F(1, 13.38) = 53.29, p < .001$). And consistent with the partial-correlation approach, the effect of disgust was estimated to be 0.20 (95% CI [0.06, 0.34], $F(1, 94.98) = 7.20, p < .01$) when simultaneously controlling for the effects of anger, fear, sadness, surprise, and happiness. The estimated effects of the other emotions in this model were as follows: anger $\gamma = 0.04$ (95% CI [-0.10, 0.17], $F(1, 239.03) = 0.27, p = .61$), fear $\gamma = 0.06$ (95% CI [-0.06, 0.18], $F(1, 202.28) = 1.03, p = .31$), sadness $\gamma = 0.19$ (95% CI [0.08, 0.30], $F(1, 229.16) = 10.65, p < .01$), surprise $\gamma = -0.01$ (95% CI [-0.08, 0.07], $F(1, 256.16) = 0.04, p = .85$), happiness $\gamma = -0.35$ (95% CI [-0.43, -0.27], $F(1, 247.34) = 73.24, p < .001$).

The effect of anger alone was estimated to be 0.38 (95% CI [0.31, 0.47], $F(1, 263.98) = 85.66, p < .001$), and when disgust and anger were entered as the only predictors the effects were as follows: disgust $\gamma = 0.35$ (95% CI [0.19, 0.52], $F(1, 63.04) = 17.09, p < .001$; anger $\gamma = 0.08$ (95% CI [-0.07, 0.23], $F(1, 250.87) = 1.09, p = .30$).

I next investigated whether the disgust slope varied by participant's sex, political identity, or religiosity by entering their main effects and interactions with disgust in the full model that

also controlled for the effects of all other emotional experiences. There were no main effects or interactions with sex or political identity. The Disgust x Religiosity interaction was estimated to be .04 (95% CI [0.01, 0.07], $F(1, 59.69) = 7.26, p < .01$). These results indicate that the effect of disgust on predicting moral judgments was stronger for more religious participants.

Discussion

The results of Study 1 provide initial evidence that thought violations elicit disgust, and that disgust is an important predictor of moral judgments. The extent to which statements were perceived as disgusting predicted subsequent ratings of immorality, and this effect remained after controlling for the influence of other emotions. This finding is particularly important for the hypothesis that moral disgust is not just a synonym for anger, and that the effect of disgust can be reliably distinguished from the effect of anger. Although disgust and anger were strongly co-activated, and anger predicted moral judgments when entered into the model alone, there was no reliable effect of anger after controlling for disgust. This suggests that it is the subjective feeling of contamination, rather than negative affect more generally, that is most strongly associated with perceived religious thought violations. Importantly, disgust was not indiscriminately associated with all negative propositions. Rather, disgust was more strongly associated with the religious false propositions relative to factually false propositions. In fact, it is rather remarkable that on a scale ranging from 1 (*not felt at all*) to 7 (*very strongly felt*) the mean self-reported disgust in response to the religious false statements was around 4. Finally it is interesting that these effects were more pronounced among more religious participants. This is consistent with a cultural learning account of disgust. That is, more religious participants were more likely to moralize their thoughts and perceive ingroup sacred values as especially “virtuous” whereas ideas that threatened those values were perceived as especially disgusting and immoral.

Chapter 5 Tables and Figures

Table 5.1. Mean moral judgment (Mean), standard deviation (SD), and sample size (N) for each statement in Study 1.

Factual Statements	Statement perceived as...					
	True			False		
	Mean	SD	N	Mean	SD	N
Penguins live in Antarctica.	3.20	1.03	15	-	-	-
Water freezes at 32 degrees Fahrenheit.	3.13	1.07	18	-	-	-
The Earth orbits around the sun.	2.90	1.06	14	6	-	1
There are 12 months in a calendar year.	3.42	0.95	19	-	-	-
The earth's moon is made out of cheese.	-	-	-	4.25	0.63	16
Canada is located south of the United States.	-	-	-	4.56	0.82	19
There are 13 letters in the English alphabet.	-	-	-	4.58	0.44	19
The Earth is flat.	-	-	-	4.82	1.24	17
Religious Statements						
A person must believe in God to be truly moral.	2.42	1.17	4	5.49	1.03	15
Jesus is the way, the truth, and the life.	1.67	1.15	3	4.46	0.80	8
The Bible is the word of God.	2.21	0.89	8	5.54	1.39	8
God has a plan for everyone.	1.64	0.80	11	3.75	0.90	8
God is a complete myth.	3.37	0.99	10	6.13	1.32	5
Praying to God is a waste of time.	3.10	1.19	10	6.05	1.24	7
Islam is the true religion of God.	3.93	0.28	5	5.36	1.10	11
Religion is a way to control gullible people.	3.10	1.60	10	5.67	1.11	5

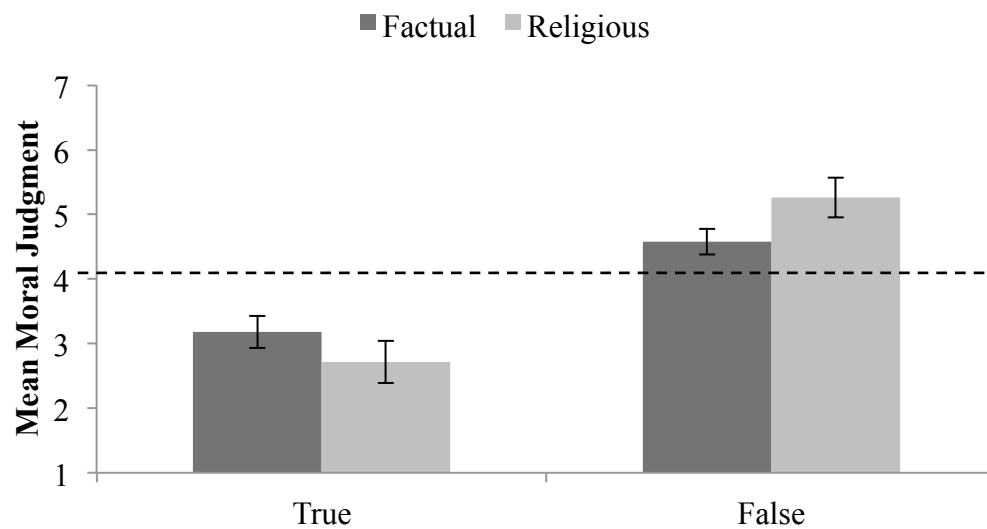
Note. Statements scoring below the midpoint of the veracity scale were coded as true, and statements scoring above midpoint of the veracity scale were coded as false.

Table 5.2. Zero order correlations (lower diagonal) and partial correlations (upper diagonal) between moral judgment and self-reported emotional experience.

	1	2	3	4	5	6	7
Moral Judgment	-	.15*	.06	.02	.17**	.11	-.51**
Disgust	.57**	-					
Anger	.53**	.88**	-				
Fear	.34**	.52**	.52**	-			
Sadness	.46**	.64**	.65**	.59**	-		
Surprise	.25**	.35**	.34**	.36**	.35**	-	
Happiness	-.52**	-.25**	-.21**	-.06	-.10	.03	-

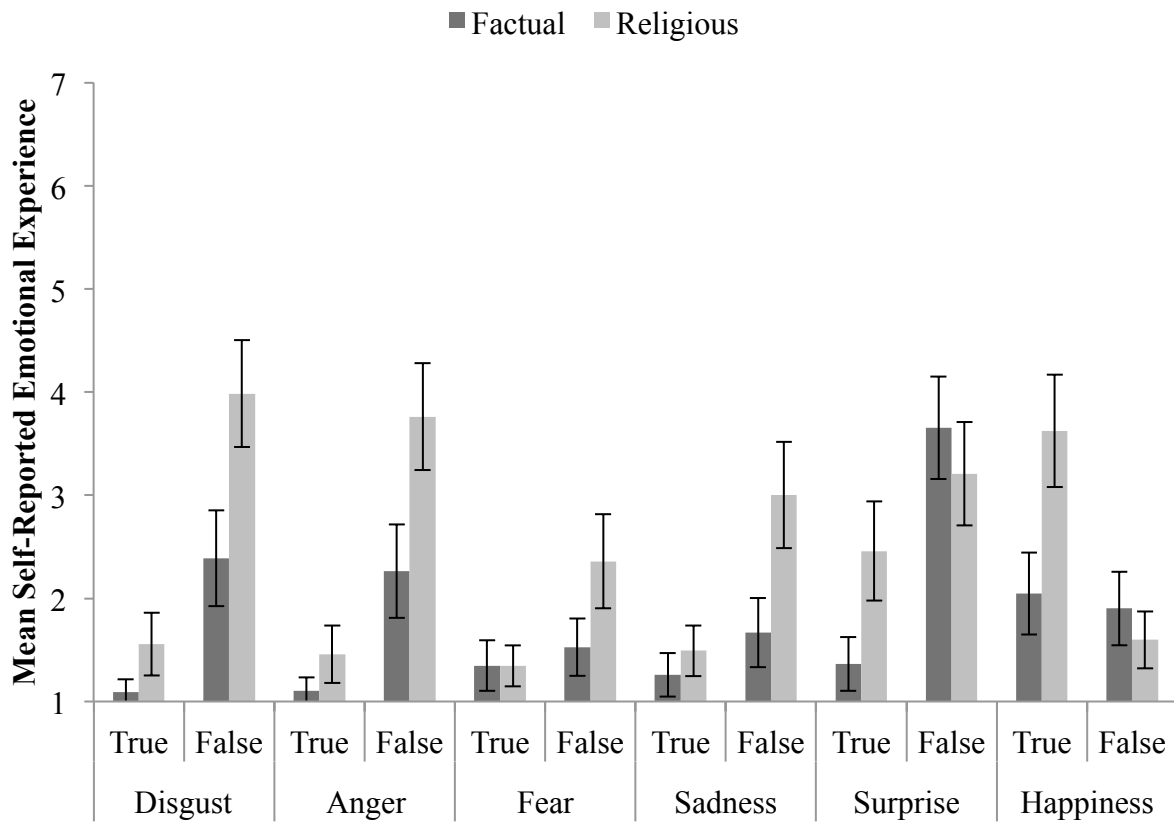
Note. * $p < .05$, ** $p < .01$

Figure 5.1. Mean moral judgment by Statement Type (Factual vs. Religious) and Veracity (True vs. False).



Note. Higher values indicate more harsh moral judgment. Error bars represent 95% confidence intervals.

Figure 5.2. Mean self-reported emotional experience for all emotions by Statement Type (Factual vs. Religious) and Veracity (True vs. False).



Note. Error bars represent 95% confidence intervals.

CHAPTER 6: STUDY 2

The primary aim of Study 2 was to examine subjective feelings of contamination as a mechanism of the experience of disgust. Using the same scales as in Study 1, participants were randomly assigned to think about one of the same sixteen statements and self-report their emotional experience. In addition, participants were asked to self-report how much the statement made them feel dirty, contaminated, and degraded. As in Study 1, whether the statement was perceived as true or false and the extent to which it was perceived as immoral was also measured.

Method

Participants

Three hundred people were recruited online from the United States through Amazon's Mechanical Turk. TurkGate version 0.4.0 (Goldin & Darlow, 2013) was used to maintain a database of each unique participant, and most importantly, to prevent those who completed Study 1 from participating again. Nineteen participants were excluded for having a completely neutral attitude toward the statement they were asked to read. This left 281 people (159 men, 122 women; mean age = 33.62 years, $SD = 12.41$) included in the analyses. Self-reported religious affiliations included 74 Atheists, 66 Protestants, 60 Agnostics, 46 Catholics, 33 "Other", 3 Buddhists, 4 Jews, 2 Muslims, and 1 Hindu.

Procedure

The Mechanical Turk HIT description, materials, and methods were identical to Study 1 with one exception. In addition to the survey sections measuring self-reported emotional experience, moral judgment, veracity, and demographics, there was a section measuring self-

reported feelings of contamination. This section appeared in between the emotional experience and moral judgment/veracity section.

Contamination. Feelings of contamination were measured using 7-point scales along three semantic differential dimensions: dirty-clean, contaminated-purified, and uplifted-degraded. Each point on the scale was labeled “extremely”, “quite”, “slightly”, or “neutral” (e.g., *extremely dirty* to *extremely clean*), and the three dimensions appeared on a single page in a different randomized order for each participant.

Results

Preparing Data for Analysis

Two of the three contamination dimensions (dirty-clean and contaminated-purified) were reverse scored so that higher values indicate stronger feelings of contamination, and the mean of the three contamination items was computed to create a composite contamination score (Cronbach’s $\alpha = .85$). As in Study 1, two of the three moral judgment dimensions (immoral-moral and wicked-virtuous) were reverse scored so that higher values indicated more harsh moral judgment, and the mean of the three items was computed to create a composite moral judgment score (Cronbach’s $\alpha = .87$). The mean of the two veracity items was computed to create a composite measure of veracity (Cronbach’s $\alpha = .92$). A dichotomous Veracity variable was created by coding values greater than 4 as false, and values less than 4 as true. Participants ($n = 19$) with a completely neutral attitude toward the statement they were assigned to read (i.e., a mean of exactly 4 on the Veracity scale) were excluded from the analysis. The mean of the four religiosity items was computed to create a composite religiosity score (Cronbach’s $\alpha = .94$).

Moral Judgments

Table 6.1 displays mean moral judgment ratings for each statement, broken down by whether the statement was perceived as true or false. The first prediction was that the religious statements perceived as false would elicit more harsh moral judgments than the factually false statements. Moral judgment scores were regressed onto variables representing Veracity (True = -0.5, False = 0.5), Statement Type (Factual = -0.5, Religious = 0.5), and their interaction. Replicating Study 1, the main effect of Statement Type was estimated to be -0.07 (95% CI [-0.33, 0.20], $t(277) = -0.50, p = .61$), indicating no meaningful difference in moral judgments between Factual and Religious statements overall. Also replicating Study 1, the mean difference in moral judgments between the True and False statements was estimated to be 1.90 (95% CI [1.63, 2.17], $t(277) = 13.98, p < .001$), and this main effect of Veracity was qualified by a Statement Type x Veracity interaction ($\beta = 1.11$, 95% CI [0.58, 1.65], $t(277) = 4.10, p < .001$)³. As displayed in Figure 6.1, the Religious False statements were perceived to be more immoral than the Factual False statements (Hedges's $g = .44$, 95% CI [0.12, 0.77]), and the Religious True statements were perceived to be more moral than the Factual True statements (Hedges's $g = .53$, 95% CI [0.18, 0.88]).

Sex (men = -0.05, women = 0.5), mean-centered political identity, and mean-centered religiosity were also entered into separate regression models along with Veracity and Statement Type to investigate any moderating effects of these variables. As in Study 1 there were no statistically significant main effects or interactions with participant sex. The Veracity x Political Identity interaction was estimated to be 0.18 (95% CI [0.02, 0.34], $t(273) = 2.16, p = .03$) indicating that the false statements elicited more harsh moral judgments among relatively more

³ The main effect of Veracity ($\beta = 0.48$, 95% CI [0.43, 0.53], $t(277) = 19.51, p < .001$) and the Statement Type x Veracity interaction ($\beta = 0.38$, 95% CI [0.28, 0.47], $t(277) = 7.72, p < .001$) were also statistically significant when Veracity was entered as a (mean-centered) continuous variable.

politically conservative participants. Also replicating Study 1, the 3-way Veracity x Statement Type x Religiosity interaction was estimated to be 0.38 (95% CI [0.14, 0.62], $t(273) = 3.17, p < .01$), indicating that the Veracity x Statement Type interaction was even stronger among more religious participants.

Disgust

The second prediction was that the religious statements perceived as false would elicit more self-reported disgust than the factual false statements. Directly replicating Study 1, the main effect of Statement Type was estimated to be 0.84 (95% CI [0.49, 1.19], $t(277) = 4.72, p < .001$), the main effect of Veracity was estimated to be 1.55 (95% CI [1.20, 1.90], $t(277) = 8.70, p < .001$), and the Statement Type x Veracity interaction was estimated to be 1.12 (95% CI [0.42, 1.82], $t(277) = 3.13, p < .01$)⁴. As seen in the left side of Figure 6.2, this interaction was driven primarily by the Religious False statements eliciting more self-reported disgust than the Factual False statements (Hedges's $g = .72$, 95% CI [0.39, 1.05]).

Sex, mean-centered political identity, and mean-centered religiosity were again entered into separate regression models along with Veracity and Statement Type to investigate any moderating effects of these variables on self-reported disgust. As in Study 1 there were no statistically significant main effects or interactions with participant sex or political identity. Contrary to Study 1, the 3-way Veracity x Statement Type x Religiosity interaction was estimated to be 0.06 (95% CI [-0.27, 0.38], $t(273) = 0.35, p = .73$) indicating that the Veracity x Statement Type interaction on disgust was not meaningfully moderated by religiosity.

⁴ The main effects of Statement Type ($\beta = 0.87$, 95% CI [0.53, 1.21], $t(277) = 5.09, p < .001$), Veracity ($\beta = 0.38$, 95% CI [0.30, 0.45], $t(277) = 10.36, p < .001$), and the Statement Type x Veracity interaction ($\beta = 0.34$, 95% CI [0.20, 0.48], $t(277) = 4.68, p < .001$) were also statistically significant when Veracity was entered as a (mean-centered) continuous variable.

Anger

As in Study 1, the effects on self-reported anger were similar to disgust (see Figure 6.2). The main effect of Statement Type was estimated to be 0.82 (95% CI [0.48, 1.16], $t(277) = 4.75$, $p < .001$), the main effect of Veracity was estimated to be 1.26 (95% CI [0.92, 1.61], $t(277) = 7.305$, $p < .001$), and the Statement Type x Veracity interaction was estimated to be 1.04 (95% CI [0.36, 1.72], $t(277) = 3.01$, $p < .01$). The moderating effect of religiosity was estimated to be 0.28 (95% CI [-0.03, 0.59], $t(273) = 1.76$, $p = .08$), and neither participant sex nor political identity moderated the Statement Type x Veracity interaction. Figure 6.2 also displays the mean emotional experience by Statement Type and Veracity for self-reported anger, fear, sadness, surprise, and happiness.

Predicting Moral Judgments

The third prediction was that self-reported disgust would predict more harsh moral judgment, and that this effect would remain even after controlling for other emotional experiences. As in Study 1 I used both correlations and mixed effects models to examine this prediction.

Correlations. As seen in the lower diagonal of Table 6.2, the zero-order correlation coefficients revealed a strong association between moral judgment and all of the self-reported emotions except fear. The partial correlation coefficients in the upper diagonal of Table 6.2 reveal that disgust remains significantly associated with more harsh moral judgments when controlling for the effects of all other emotional experiences ($r = .17$).

Mixed Effects Models. Consistent with the zero-order correlation approach above, when moral judgment scores were regressed onto self-reported disgust alone the effect was estimated to be 0.48 (95% CI [0.37, 0.58], $F(1, 12.76) = 79.01$, $p < .001$). And consistent with the partial-

correlation approach, the effect of disgust was estimated to be 0.26 (95% CI [0.14, 0.38], $F(1, 44.31) = 17.28, p < .001$) when simultaneously controlling for the effects of anger, fear, sadness, surprise, and happiness. The estimated effects of the other emotions in this model were as follows: anger $\gamma = 0.17$ (95% CI [0.06, 0.29], $F(1, 116.78) = 7.34, p < .01$), fear $\gamma = -0.17$ (95% CI [-0.29, -0.05], $F(1, 124.86) = 6.21, p = .01$), sadness $\gamma = 0.07$ (95% CI [-0.03, 0.16], $F(1, 269.19) = 1.78, p = .18$), surprise $\gamma = 0.05$ (95% CI [-0.02, 0.12], $F(1, 244.16) = 1.60, p = .21$), happiness $\gamma = -0.28$ (95% CI [-0.35, -0.21], $F(1, 270.85) = 62.31, p < .001$).

The effect of anger alone was estimated to be 0.42 (95% CI [0.33, 0.51], $F(1, 276.52) = 85.92, p < .001$), and when disgust and anger were entered as the only predictors the effects were as follows: disgust $\gamma = 0.40$ (95% CI [0.27, 0.54], $F(1, 35.89) = 32.71, p < .001$; anger $\gamma = 0.10$ (95% CI [-0.02, 0.22], $F(1, 145.20) = 2.21, p = .14$).

I next investigated whether the disgust slope varied by participant's sex, political identity, or religiosity by entering their main effects and interactions with disgust in the full model that also controlled for the effects of all other emotional experiences. There were no main effects or interactions with any of these individual difference variables.

Contamination

In addition to replicating the primary effects of Study 1, the primary purpose of Study 2 was to examine whether the association between disgust and moral judgments of ideas can be explained, at least in part, by their conceptualization as contaminants. That is, do religious statements perceived as false actually make people feel "impure"? To examine this question, impurity scores were first regressed onto variables representing Veracity (True = -0.5, False = 0.5), Statement Type (Factual = -0.5, Religious = 0.5), and their interaction. The main effect of Statement Type was estimated to be -0.05 (95% CI [-0.28, 0.17], $t(277) = -0.47, p = .64$),

indicating no differences in feelings of contamination between factual and religious statements overall. The mean difference between the true and false statements was estimated to be 1.05 (95% CI [0.83, 1.28], $t(277) = 9.21, p < .001$), and this main effect was qualified by a Statement Type x Veracity interaction ($\beta = 1.30$, 95% CI [0.85, 1.75], $t(277) = 5.70, p < .001$)⁵. As seen in Figure 6.3, this interaction was driven by the Religious False statements eliciting stronger feelings of contamination than the Factual False statements (Hedges's $g = .66$, 95% CI [0.33, 0.99]) and the Religious True statements eliciting stronger feelings of purity than the Factual True statements (Hedges's $g = .69$, 95% CI [0.33, 1.04]).

As in previous analyses I also examined whether this effect was moderated by participant's sex, political identity, or religiosity. There was a Statement Type x Sex interaction estimated to be -0.52 (95% CI [-0.97, 0.07], $t(273) = -2.26, p = .02$), indicating that the overall effect of Religious statements on feelings of contamination was stronger among women. There were no main effects or interactions with political identity. Finally, there was a main effect of Religiosity ($\gamma = -0.08$, 95% CI [-0.13, -0.03], $t(273) = -3.24, p < .01$), a Religiosity x Veracity interaction ($\gamma = 0.13$, 95% CI [0.03, 0.23], $t(273) = 2.52, p = .01$), and both of these were qualified by a 3-way Religiosity x Veracity x Statement Type interaction ($\gamma = 0.35$, 95% CI [0.16, 0.55], $t(273) = 3.52, p < .001$). These effects suggest that the Veracity x Statement Type interaction on feelings of contamination was stronger among relatively more religious participants.

Mediation. To investigate the indirect effect of disgust on moral judgments through feelings of contamination I used the “mediation” package in R (Tingley, Yamamoto, Keele, & Imai, 2013). Average indirect effects were computed using 1000 simulations with nonparametric

⁵ The main effect of Veracity ($\beta = 0.27$, 95% CI [0.23, 0.32], $t(277) = 12.28, p < .001$) and the Statement Type x Veracity interaction ($\beta = 0.36$, 95% CI [0.27, 0.45], $t(277) = 8.00, p < .001$) were also statistically significant when Veracity was entered as a (mean-centered) continuous variable.

bias corrected and accelerated bootstrap confidence intervals. The average indirect effect of disgust on moral judgment through feelings of contamination was 0.22 (95% CI [0.15, 0.29]; see Figure 6.4). In other words, approximately 46% of the effect of disgust on moral judgment could be explained by the extent to which a statement made people feel “clean” or “dirty”. This effect remained after controlling for the effects of anger, fear, sadness, and surprise (average indirect effect = 0.15, 95% CI [0.01, 0.28]⁶; see Figure 6.5).

Discussion

Study 2 directly replicated the primary effects of Study 1. Religious statements perceived as false elicited more harsh moral judgments and stronger reports of disgust than the factual false statements, and the extent to which the statements were perceived as disgusting predicted subsequent ratings of immorality. The latter effect again remained after controlling for the influence of other emotions. Importantly, anger was associated with more harsh moral judgments when entered into the model alone, but with disgust and anger entered together only disgust remained a reliable predictor of moral judgment. However there were also some noteworthy differences from Study 1. Recall that based on the mixed effects models with all emotions in Study 1, sadness and happiness also emerged (along with disgust) as statistically significant predictors of moral judgments. In Study 2 anger, fear, and happiness all emerged (along with disgust) as statistically significant predictors of moral judgments with all of the emotions entered in the same model. Thus across the two studies the only effects that reliably predicted moral judgments were disgust and happiness. Moreover, in Study 1 religiosity

⁶ The indirect effect of disgust on moral judgment through contamination was not different from zero (95% CI [-0.05, 0.13]) when adding happiness as an additional control variable. Happiness was strongly negatively associated with both feelings of contamination (95% CI [-0.36, -0.26]) and harsh moral judgments (95% CI [-0.24, -0.10]).

moderated the Veracity x Statement Type interactions for both moral judgments and self-reported disgust, but only for moral judgments (and contamination) in Study 2.

Study 2 also extended the findings of Study 1 by demonstrating that the effect of disgust on subsequent moral judgments is due, at least in part, to subjective feelings of contamination. Importantly it was self-reported disgust, not other negative emotional experiences such as anger or sadness that was associated with contamination. Religiosity also moderated the Veracity x Statement Type interaction on feelings of contamination, which is again consistent with a cultural learning account of disgust. Relatively more religious participants were more likely to perceive ingroup sacred values as especially “pure” whereas ideas that threatened those values were perceived as especially contaminating.

Chapter 6 Tables and Figures

Table 6.1. Mean moral judgment (Mean), standard deviation (SD), and sample size (N) for each statement in Study 2.

Factual Statements	<i>Statement perceived as...</i>					
	True			False		
	<i>Mean</i>	<i>SD</i>	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>N</i>
Penguins live in Antarctica.	3.02	0.96	16	6.67	-	1
Water freezes at 32 degrees Fahrenheit.	3.63	0.59	17	-	-	-
The Earth orbits around the sun.	2.82	1.25	15	4.00	0.47	2
There are 12 months in a calendar year.	3.27	1.13	16	-	-	-
The earth's moon is made out of cheese.	-	-	-	3.80	0.87	17
Canada is located south of the United States.	3.67	0.94	2	4.92	0.76	16
There are 13 letters in the English alphabet.	-	-	-	4.78	0.85	18
The Earth is flat.	-	-	-	4.65	0.94	20
Religious Statements						
A person must believe in God to be truly moral.	2.08	1.10	4	5.19	1.32	14
Jesus is the way, the truth, and the life.	1.78	1.01	9	4.25	1.29	8
The Bible is the word of God.	2.04	1.05	8	4.33	0.73	8
God has a plan for everyone.	1.47	0.72	10	4.13	1.08	10
God is a complete myth.	3.00	1.31	8	6.03	1.02	10
Praying to God is a waste of time.	3.67	0.64	8	5.43	1.12	10
Islam is the true religion of God.	3.92	0.57	4	5.44	1.00	13
Religion is a way to control gullible people.	3.18	1.42	13	5.08	0.32	4

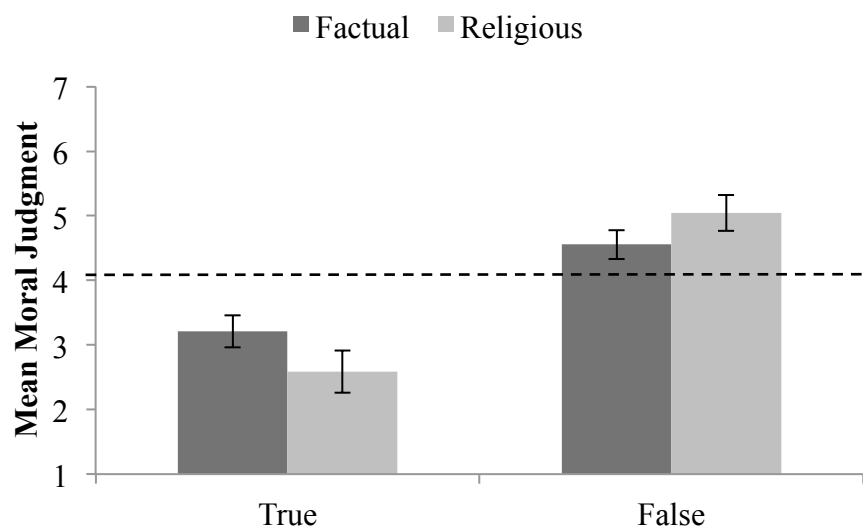
Note. Statements scoring below the midpoint of the veracity scale were coded as true, and statements scoring above midpoint of the veracity scale were coded as false.

Table 6.2. Zero order correlations (lower diagonal) and partial correlations (upper diagonal) between moral judgment and self-reported emotional experience.

	1	2	3	4	5	6	7
Moral Judgment	-	.21**	.17**	-.15*	.08	.17**	-.53**
Disgust	.55**	-					
Anger	.49**	.79**	-				
Fear	.07	.35**	.39**	-			
Sadness	.34**	.56**	.54**	.46**	-		
Surprise	.24**	.32**	.30**	.26**	.30**	-	
Happiness	-.55**	-.23**	-.15*	.08	-.09	.05	-

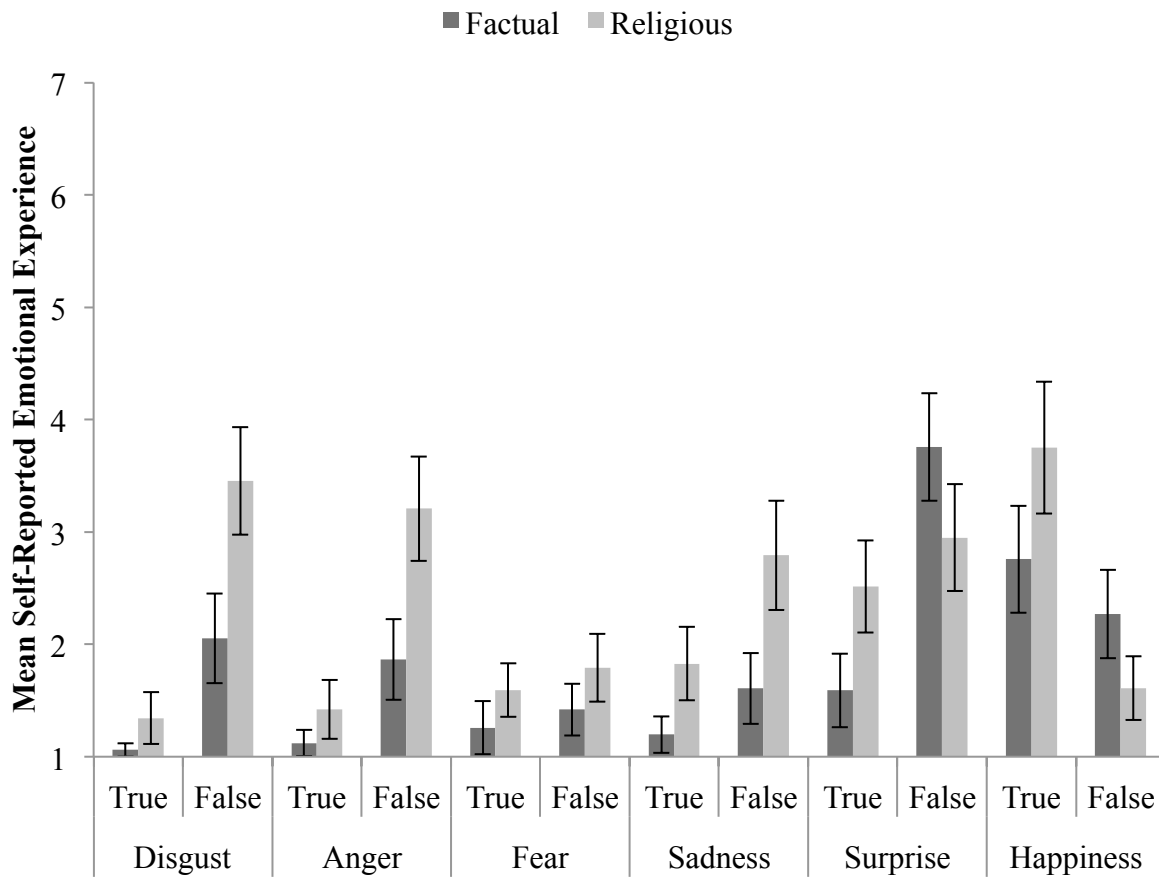
Note. * $p < .05$, ** $p < .01$

Figure 6.1. Mean moral judgment by Statement Type (Factual vs. Religious) and Veracity (True vs. False).



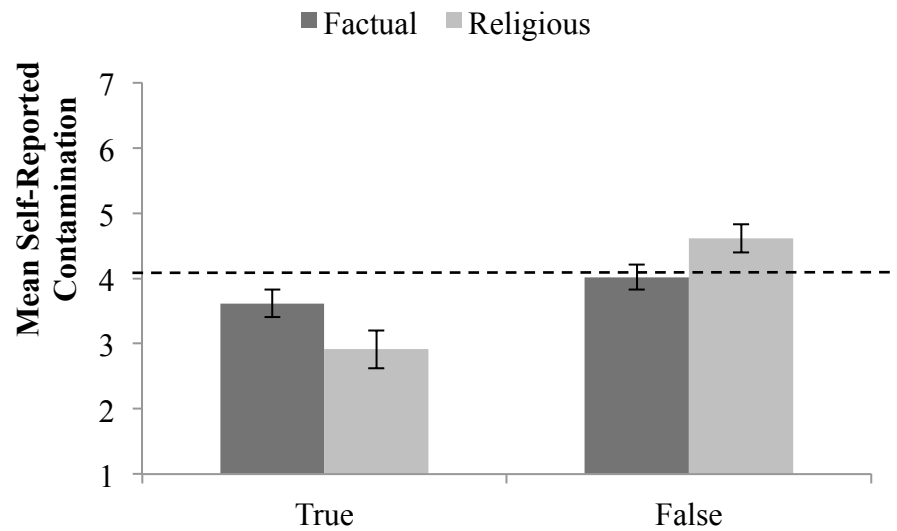
Note. Higher values indicate more harsh moral judgment. Error bars represent 95% confidence intervals.

Figure 6.2. Mean self-reported emotional experience for all emotions by Statement Type (Factual vs. Religious) and Veracity (True vs. False).



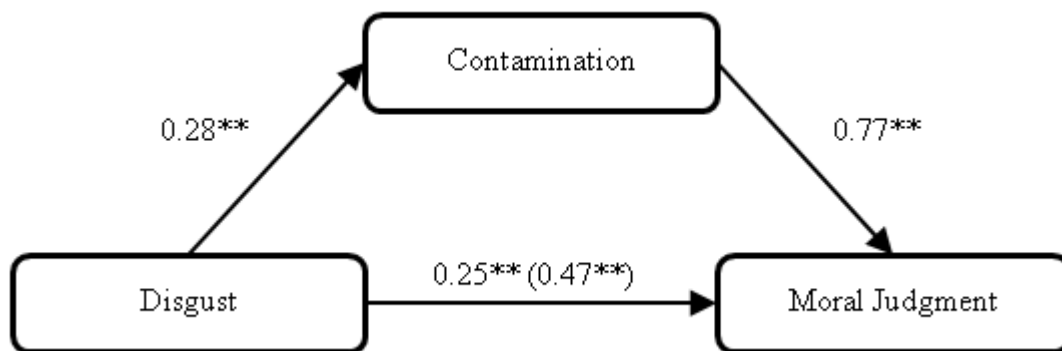
Note. Error bars represent 95% confidence intervals.

Figure 6.3. Mean self-reported contamination by Statement Type (Factual vs. Religious) and Veracity (True vs. False).



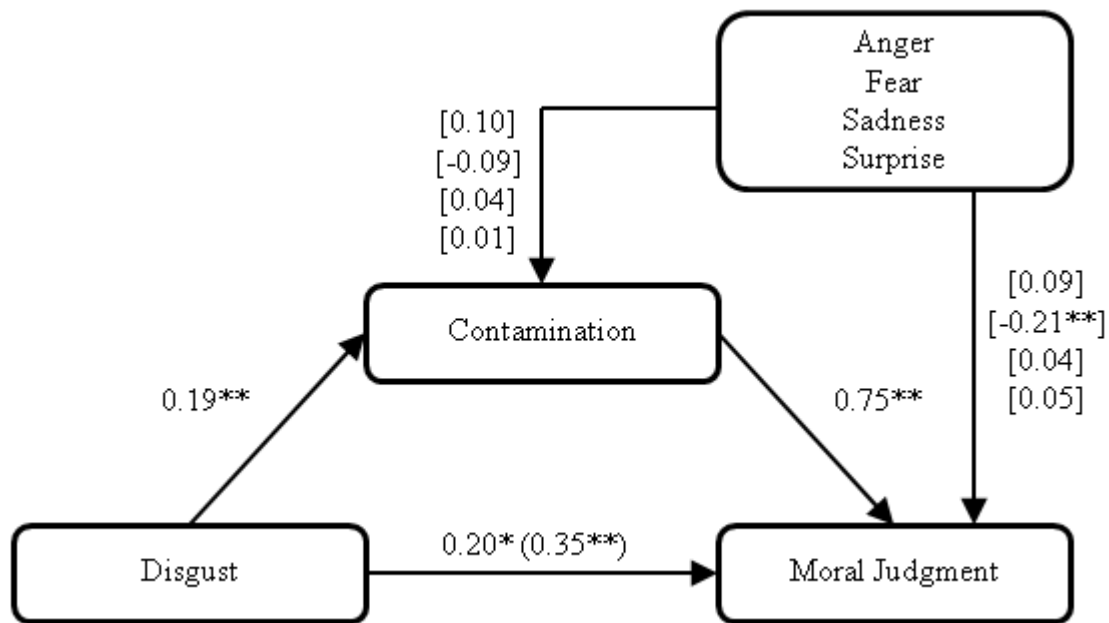
Note. Error bars represent 95% confidence intervals.

Figure 6.4. Indirect effect of disgust on moral judgment through contamination.



Note. ** $p < .01$. The value in parentheses estimates the total effect of disgust on moral judgment.

Figure 6.5. Indirect effect of disgust on moral judgment through contamination, controlling for the effects of anger, fear, sadness, and surprise.



Note. * $p < .05$, ** $p < .01$. The value in parentheses estimates the total effect of disgust on moral judgment when controlling for the effects of other emotions. The values in brackets represent the estimated effects of anger, fear, sadness, and surprise, respectively, on feelings of contamination and moral judgment.

CHAPTER 7: STUDY 3

Studies 1 and 2 established that self-reported disgust, driven in part by feelings of contamination, is associated with perceived religious thought violations. In studies 3 and 4 I used facial electromyography (EMG) to examine the physiological correlates of this effect. If physical contaminants and religious thought violations both elicit facial muscle activity consistent with an oral/nasal inhibition response (i.e., wrinkled nose, raised upper lip), then this would provide evidence that religious thought violations elicit physical disgust. However, if people report that religious thoughts elicit “disgust” but there is no evidence of an oral/nasal inhibition response, then this would provide evidence that disgust is being used metaphorically to express contamination and give concrete meaning to abstract religious thoughts.

The primary purpose of the present study was to first replicate previous EMG research using physically disgusting stimuli, before moving on to more abstract thought violations in Study 4. This will allow me to investigate whether religious thought violations elicit physical disgust (i.e., oral/nasal inhibition) or not. Although there are a variety of disgust facial expressions, disgust is generally associated with a wrinkled nose and raised upper lip (Rozin, Lowery, & Ebert, 1994). These facial movements are caused by the levator labii muscle (Tassinari & Cacioppo, 2000), and previous research has demonstrated an association between levator labii muscle activity and bitter tastes (Chapman et al., 2009), viewing disgusting photographs (Chapman et al., 2009), processing disgust related words (Niedenthal, Winkielman, Mondillon, & Vermeulen, 2009), unfairness (Cannon et al., 2011; Chapman et al., 2009), and moral purity violations (Cannon et al., 2011). Another important facial signal of negative affect is characterized by a knitted brow (Ekman et al., 1969), which is caused by the corrugator supercilii muscle (Tassinari & Cacioppo, 2000). Previous research has linked corrugator

supercilii muscle activity with processing anger related words (Niedenthal et al., 2009) and harm violations (Cannon et al., 2011). The present study aimed to replicate these findings by asking participants to think about purity and harm virtues and vices as levator labii and corrugator supercilii facial muscle activity was measured.

Participants

Sixteen undergraduate students (4 men, 12 women; mean age = 18.56 years, $SD = 0.73$) from the University of Illinois at Urbana-Champaign were recruited from the Psychology Department's course credit subject pool. Self-reported religious affiliations included 12 Catholics and 4 Protestants.

Procedure

Participants were seated at a computer in a private lab room and asked to review and sign a consent form stating that the purpose of the research was to “investigate people’s emotional responses to different kinds of information.” After signing the consent form and receiving a verbal explanation of what to expect, a researcher prepared the participant’s skin and attached electrodes using Tassinari and Cacioppo’s (2000) guidelines. The skin at each site was cleaned with a handi-wipe, lightly abraded, and prepped with a pad saturated in 70% isopropyl alcohol. Electrodes were placed over the levator labii and corrugator supercilii muscle sites, and the ground electrode was placed on the top-center of the forehead. Inter-electrode impedances were measured using BIOPAC’s EL-CHECK impedance checker, and every effort was made to reduce impedance to less than 10 kOhms. Participants next completed a demographics questionnaire and a religiosity questionnaire as in Studies 1 and 2, along with a ten item personality inventory (Gosling, Rentfrow, & Swann Jr., 2003). This time allowed participants to get accustomed to having electrodes attached to their face, and no EMG data was recorded

during this introductory period. The main task consisted of 30 trials, and each trial had four parts. First, a fixation cross (“+”) appeared at the center of the screen for 2 seconds and participants were asked to do their best to relax and clear their mind during this period. Second, a statement describing 1 of 30 situations appeared at the center of the screen and participants also heard a recording of the statement over their headphones. Third, a screen appeared for 6 seconds that read “Please think about what you would FEEL in this situation.” Finally, a series of emotion rating scales appeared on the screen one at a time in randomized order and participants were asked to indicate how much they experienced each of six emotions as they thought about the situation described (0 = *not felt at all*, 6 = *very strongly felt*): disgust, anger, fear, sadness, surprise, and happiness. Each trial ended with a screen presented for 2 seconds that read “Please wait.”

Materials

The thirty statements were adapted from the stimuli used by Cannon et al. (2011). Ten statements described physical purity violations (e.g., “drinking a glass of warm, spoiled milk”), ten statements described harm violations (e.g., “someone kicking your pet dog”), five statements described purity virtues (e.g., “exercising to stay healthy”) and five statements described harm virtues (e.g., “volunteering at a soup kitchen”). See Appendix for the full list of statements used.

Equipment

Electromyographic data was recorded using 4mm Ag/AgCl reusable snap electrodes filled with electrode gel and placed using double-sided adhesive disks. Muscle activity was sampled at a rate of 1000 Hz (band limited from 5 Hz to 500 Hz) using the BIOPAC MP150 acquisition system with a BioNomadix two channel EMG module. Wired leads (45 cm long) attached the electrodes to a wireless transmitting device that was worn around the participant’s

upper-left arm. BIOPAC's STP100C module was used along with Empirisoft's DirectRT software to record and synchronize stimulus presentation. A webcam conspicuously recorded participant's face during the study to monitor extraneous movement.

Results

Preparing Data for Analysis

Prior to analysis the raw EMG signals were rectified and integrated (smoothed) using a time constant of 5 ms (Blascovich, Vanman, Mendes, & Dickerson, 2011; p. 61). At each site, mean muscle activity for the 500 ms period prior to stimulus onset (i.e., the last 500 ms of the 2 second presentation of the fixation cross) was subtracted from the mean muscle activity during the six second period after stimulus offset. This change score thus controlled for baseline muscle activity, and was used in all subsequent analyses. Raw data consisted of a total of 479 observations (16 participants x 30 stimuli; EMG data for 1 of the 480 possible trials was missing due to researcher error). Mixed effects models were used where appropriate to treat both participants and stimuli (statements) as random effects (Judd et al., 2012).

Self-Reported Emotional Experience

I first investigated whether, as expected, self-reported disgust was most strongly associated with physical purity violations and self-reported anger was most strongly associated with harm violations. In two separate analyses, disgust and anger were regressed onto variables representing Moral Foundation (Harm = -0.5, Purity = 0.5), Valence (Virtue = -0.5, Vice = 0.5), and their interaction. For disgust, the main effect of Moral Foundation was estimated to be 0.89 (95% CI [0.47, 1.30], $F(1, 26.04) = 16.35, p < .01$), the main effect of Valence was estimated to be 4.17 (95% CI [3.75, 4.59], $F(1, 26.04) = 363.07, p < .01$), and the Moral Foundation x Valence interaction was estimated to be 1.67 (95% CI [0.83, 2.50], $F(1, 26.04) = 14.48, p < .01$;

see Figure 7.1). In other words, disgust was the primary emotion elicited in response to physical purity violations. For anger, the main effect of Moral Foundation was estimated to be -1.06 (95% CI [-1.54, -0.57], $F(1, 26.04) = 17.30, p < .01$), the main effect of Valence was estimated to be 3.32 (95% CI [2.83, 3.80], $F(1, 26.04) = 170.15, p < .01$), and the Moral Foundation x Valence interaction was estimated to be -2.08 (95% CI [-3.06, -1.11], $F(1, 26.04) = 16.80, p < .01$; see Figure 7.1). In other words, anger was the primary emotion elicited in response to harm violations. Figure 7.1 also displays mean self-reported fear, sadness, surprise, and happiness for each statement category.

Muscle Activity

I next investigated the extent to which levator labii muscle activity was associated with purity violations and with self-reported feelings of disgust. Change in levator labii activity in response to purity vices was estimated to be 0.0027 (95% CI [0.0015, 0.0038], $t(29.9) = 4.44, p < .01$), and across the 30 statements mean change in levator labii activity was positively associated with mean self-reported disgust ($r = .45, p = .01$; see Table 7.1). As seen in Figure 7.2, change in levator labii activity in response to purity violations remained relatively constant across the 6 second interval. I also regressed levator labii change scores onto variables representing Moral Foundation (Harm = -0.5, Purity = 0.5), Valence (Virtue = -0.5, Vice = 0.5), and their interaction. The main effect of Moral Foundation was estimated to be 0.0014 (95% CI 0.0005, 0.0024], $F(1, 26.11) = 8.31, p = .01$). The main effect of Valence was estimated to be 0.0008 (95% CI [-0.0002, 0.0018], $F(1, 26.11) = 2.75, p = .11$). The Moral Foundation x Valence interaction was estimated to be 0.002 (95% CI [-0.0002, 0.0036], $F(1, 26.11) = 3.15, p = .09$; see Figure 7.3).

Next I investigated the extent to which corrugator supercilii muscle activity was associated with harm violations and with self-reported feelings of negative affect. Change in corrugator supercilii activity in response to harm vices was estimated to be 0.0024 (95% CI [0.00006, 0.0048], $t(21.65) = 2.02, p = .06$), and across the 30 statements mean change in corrugator supercilii activity was positively associated with mean self-reported anger ($r = .39, p = .03$) and sadness ($r = .39, p = .03$; see Table 7.1). As seen in Figure 7.4, change in corrugator supercilii activity in response to harm violations remained relatively constant across the 6 second interval. I also regressed corrugator supercilii change scores onto variables representing Moral Foundation (Harm = -0.5, Purity = 0.5), Valence (Virtue = -0.5, Vice = 0.5), and their interaction. The main effect of Moral Foundation was estimated to be 0.00005 (95% CI [-0.0014, 0.0015], $F(1, 26.09) = 0.01, p = .94$). The main effect of Valence was estimated to be 0.001 (95% CI [-0.0004, 0.0025], $F(1, 26.09) = 1.91, p = .18$). The Moral Foundation x Valence interaction was estimated to be -0.002 (95% CI [-0.0055, 0.0007], $F(1, 26.09) = 2.02, p = .17$; see Figure 7.4).

Discussion

Using physically disgusting stimuli (e.g., vomit), this study replicated previous research by demonstrating an association between purity violations and levator labii muscle activity. Participants self-reported disgust as the primary emotion in response to purity violations, and self-reported disgust was correlated with levator labii muscle activity ($r = .45$). This is important to establish that levator labii muscle activity is associated with physical disgust. Participants also self-reported anger as the primary emotion in response to harm violations, and self-reported anger was correlated with corrugator supercilii muscle activity ($r = .39$). Corrugator supercilii muscle activity was also correlated with sadness ($r = .39$), and generally positively correlated (r 's

> .25) with disgust, fear, and surprise. This is consistent with the corrugator supercilii muscle being associated more generally with negative affect (Cacioppo et al., 2000). Most importantly, this study laid the groundwork to ask a theoretically important question in Study 4: is there evidence that religious thought violations elicit physical disgust (i.e., oral/nasal inhibition)?

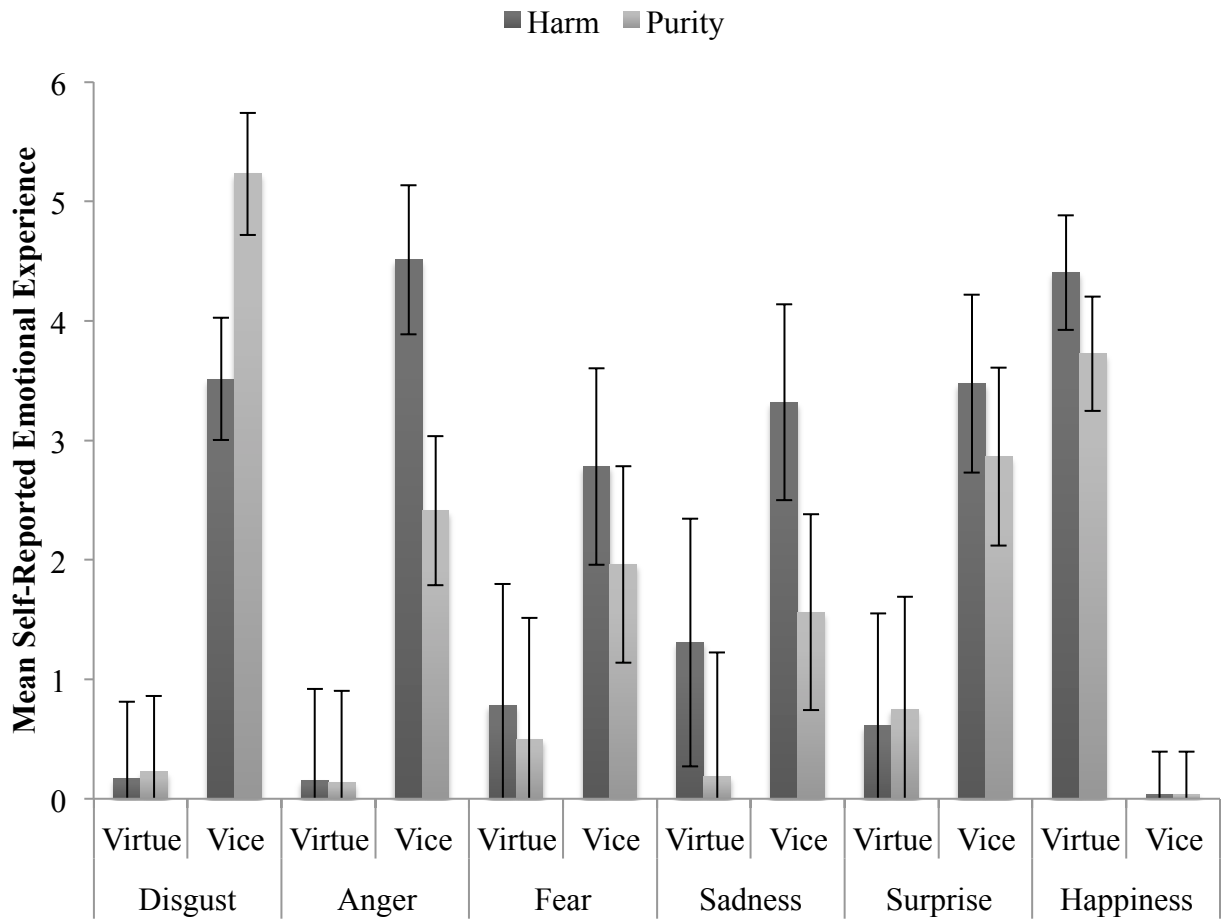
Chapter 7 Tables and Figures

Table 7.1. Zero order correlations between mean change in muscle activity and mean self-reported emotional experience.

	1	2	3	4	5	6	7	8
Levator Labii	-							
Corrugator Supercilii	.02	-						
Disgust	.45*	.25	-					
Anger	-.01	.39*	.65**	-				
Fear	-.06	.29	.51**	.67**	-			
Sadness	-.18	.39*	.45*	.76**	.61**	-		
Surprise	.10	.27	.68**	.81**	.75**	.51**	-	
Happiness	-.25	-.30	-.89**	-.81**	-.66**	-.52**	-.78**	-

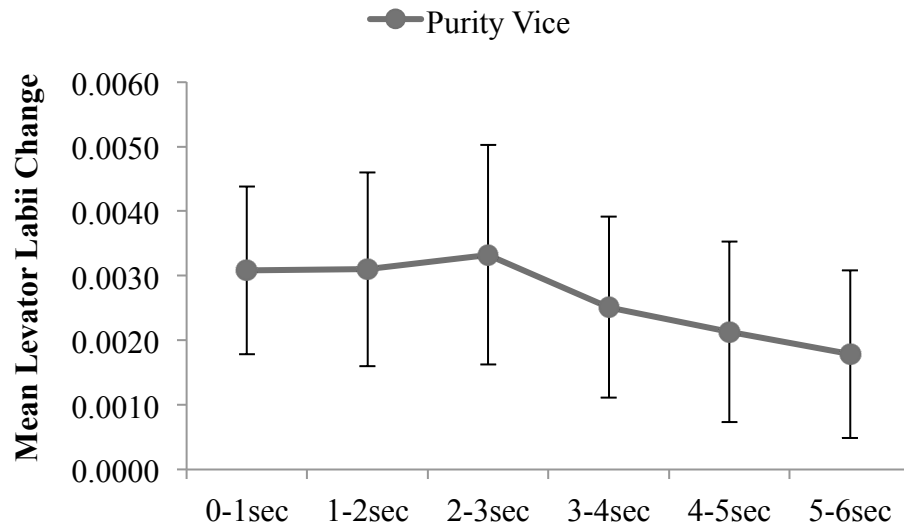
Note. * $p < .05$, ** $p < .01$. For each statement, the mean of each variable was computed and so values represent correlations across the 30 statements.

Figure 7.1. Mean self-reported emotional experience for all emotions by Moral Foundation (Harm vs. Purity) and Valence (Virtue vs. Vice).



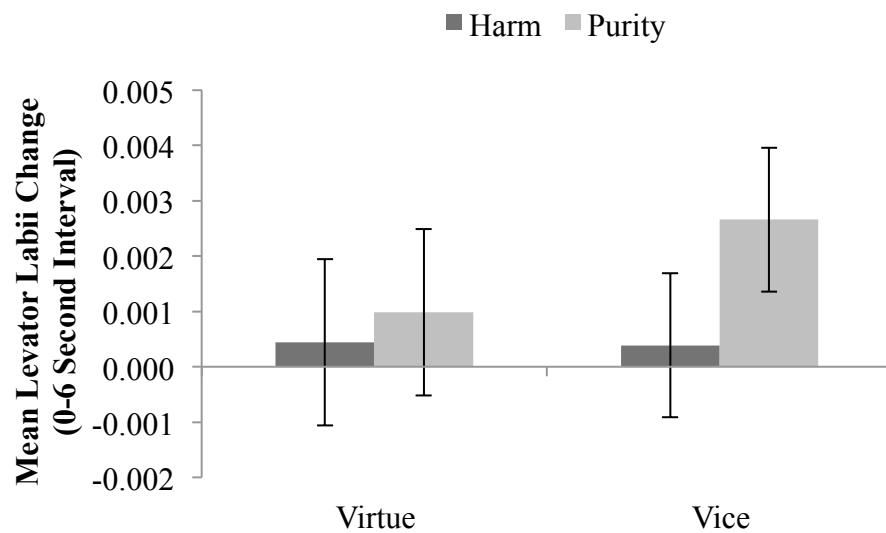
Note. Error bars represent 95% confidence intervals.

Figure 7.2. Mean change in levator labii muscle activity in response to purity violations for each 1 second period during the 6 second interval.



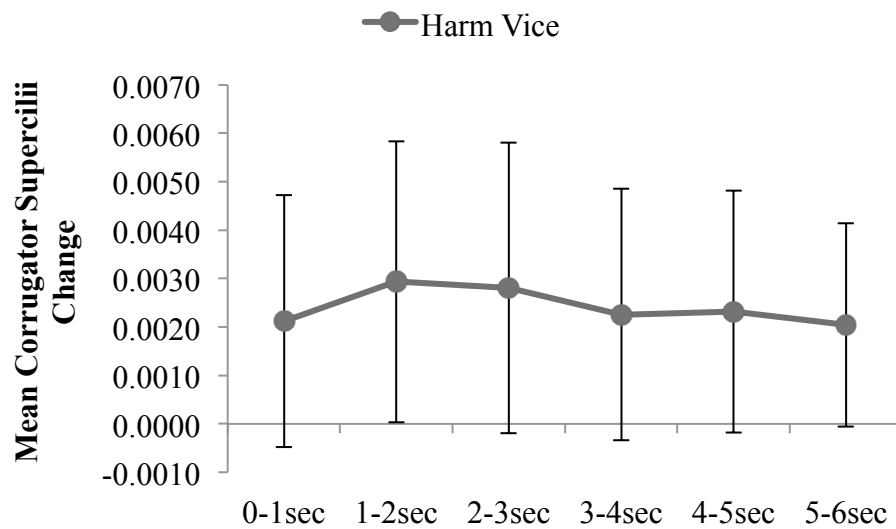
Note. Error bars represent 95% confidence intervals.

Figure 7.3. Mean change in levator labii muscle activity by Moral Foundation (Harm vs. Purity) and Valence (Virtue vs. Vice).



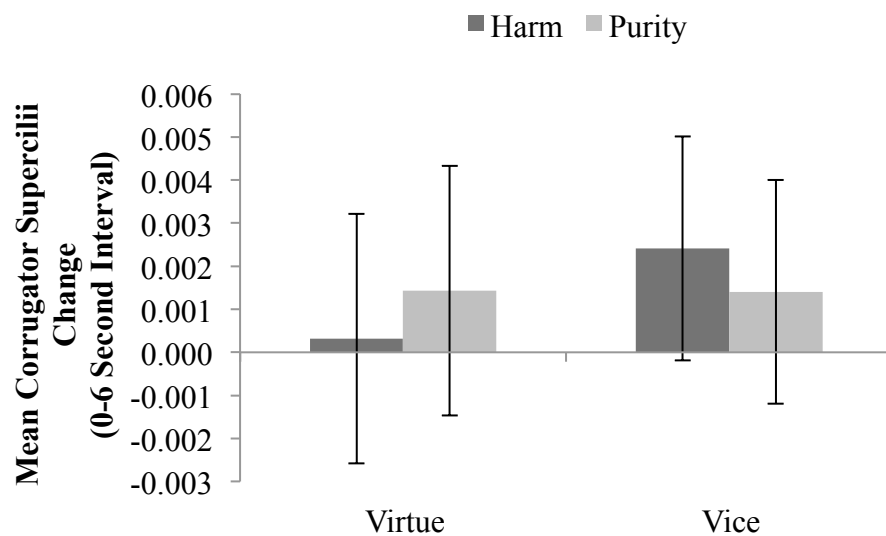
Note. Error bars represent 95% confidence intervals.

Figure 7.4. Mean change in corrugator supercilii muscle activity in response to harm violations for each 1 second period during the 6 second interval.



Note. Error bars represent 95% confidence intervals.

Figure 7.5. Mean change in corrugator supercilii muscle activity by Moral Foundation (Harm vs. Purity) and Valence (Virtue vs. Vice).



Note. Error bars represent 95% confidence intervals.

CHAPTER 8: STUDY 4

In Study 3, all of the purity violations involved physically disgusting stimuli: objects directly related to disease and threats to the physical body. Having replicated that these prototypical physically disgusting stimuli are associated with levator labii facial muscle activity, the primary purpose of the present study was to examine whether perceived religious thought violations elicit the same pattern of facial muscle activity. In other words, is there evidence that disgust in response to disease-related threats to the physical body is the same emotional response as disgust in response to perceived thought violations? Recall that Chapman and colleagues (2009) found levator labii muscle activity was associated with tasting a bitter drink, viewing prototypically disgusting pictures, and being treated unfairly in an economic game. This similar pattern of facial muscle activity across diverse domains was interpreted as evidence for the “oral origins of moral disgust” (Chapman et al., 2009). Only one other study has measured facial EMG in response to moral violations, and these involved mostly physically disgusting stimuli (e.g., “someone who rarely showers and smells bad”) or body modifications (e.g., “someone who injected drugs into his arm with a syringe”) (Cannon et al., 2011). It is thus an open question whether moral violations that involve only the mind also elicit levator labii muscle activity. If they do, this would provide further evidence for the oral origins of moral disgust (i.e., that religious thought violations elicit an oral/nasal inhibition response). On the other hand, if participants self-report that they are “disgusted” but there is no evidence of an oral/nasal inhibition response, then this would provide evidence that participants are using the word disgust metaphorically to communicate subjective feelings of contamination and make meaning of their experience. To address this question, Christian participants were asked to think about a series of twenty four statements—eight factual and sixteen religious—as corrugator supercilii and levator

labii muscle activity was recorded. As in Studies 1 and 2, participants also self-reported their emotional experience, general attitudes, and the extent to which each statement was perceived as immoral.

Method

Participants

Thirty-eight undergraduate students from the University of Illinois at Urbana-Champaign were recruited from the Psychology Department's course credit subject pool. A prescreening questionnaire was used to recruit only participants that were currently affiliated with a Christian religion and who reported that their religion was "quite important" or "very important" to them. Three participants were excluded from analyses: one for coughing/sniffing throughout the study (and thus causing a lot of false positive EMG activity), one for texting on their cell phone during the study and appearing to rush through the procedure, and one for not completing the central evaluation/moral judgment measures. This left data from 35 participants (8 men, 27 women; mean age = 18.74 years, $SD = 0.83$) included in the analyses.

Procedure

Equipment and introductory procedures were identical to Study 3. The main task was separated into two blocks, with each block consisting of twenty-four trials. Block 1 consisted of four main parts. First, a fixation cross ("+") appeared at the center of the screen for two seconds and participants were asked to do their best to relax and clear their mind during this period. Second, one of twenty-four statements was randomly selected to appear at the center of the screen and participants also heard a recording of the statement over their headphones. The twenty-four propositions were written to include eight factual statements and sixteen religious statements. Among the eight factual statements, four were true (e.g., "The earth orbits around

the sun”) and four were false (e.g., “The earth’s moon is made out of cheese”). Among the sixteen religious statements, eight supported a traditional Christian belief (e.g., “Jesus is the way, the truth, and the life”) and eight supported non-Christian belief (e.g., “Praying to God is a waste of time”; see Table 8.1 for complete list of statements). Third, a screen appeared for six seconds that read “How does having this thought in your mind make you FEEL?” Finally, a series of emotion rating scales appeared on the screen one at a time in randomized order and participants were asked to indicate how much they experienced each of six emotions as they thought about the statement (0 = *not felt at all*, 6 = *very strongly felt*): disgust, anger, fear, sadness, surprise, and happiness. Each trial ended with a screen presented for two seconds that read “Please wait.”

In Block 2 participants read and heard all twenty-four statements for a second time in randomized order. After each statement, participants evaluated it using 7-point semantic differential scales measuring moral judgment (immoral-moral, wicked-virtuous, and good-bad), and veracity (true-false and acceptable-unacceptable) as in Studies 1 and 2. Each point on the scale was labeled “extremely”, “quite”, “slightly”, or “neutral” (e.g., *extremely immoral* to *extremely moral*), and the five dimensions appeared on the screen one at a time in a different randomized order for each trial.

After finishing blocks 1 and 2, participants completed the three domain disgust scale (Tybur et al., 2009), the moral foundations questionnaire (Graham, Haidt, & Nosek, 2008), and a series of funnel debriefing questions (Wilson, Aronson, & Carlsmith, 2010).

Results

Preparing Data for Analysis

As in Studies 1 and 2, two of the three moral judgment items (immoral-moral and wicked-virtuous) were reverse scored so that higher values indicated more harsh moral

judgment, and the mean of the three items was computed to create a composite moral judgment score. The mean of the two veracity items was computed to create a composite measure of perceived veracity. Raw data consisted of a total of 840 possible observations (thirty-five participants x twenty-four stimuli) and forty-one trials were excluded because participants indicated a completely neutral attitude (i.e., a veracity mean of exactly four), leaving 799 observations included in the analyses. A dichotomous Veracity variable was created by coding the a priori false statements as false, and the a priori true statements as true. The mean of the religiosity items was computed to create a composite religiosity score ($\alpha = .80$), and subscales from the three domain disgust scale (physical disgust sensitivity $\alpha = .85$; sexual disgust sensitivity $\alpha = .61$; moral disgust sensitivity $\alpha = .85$) and moral foundations questionnaire (harm $\alpha = .66$; fairness $\alpha = .48$; ingroup $\alpha = .45$; authority $\alpha = .43$; purity $\alpha = .70$) were also computed.

As in Study 3, the raw EMG signals were rectified and smoothed using a time constant of five milliseconds. The mean muscle activity for the 500 ms period prior to stimulus onset was subtracted from the mean muscle activity during the six second period after stimulus offset, and unless noted otherwise this change score was used in all subsequent analyses.

Self-Report

Moral Judgments. Table 8.1 displays mean moral judgment ratings for each statement. I first investigated whether the religious false statements elicited more harsh moral judgments than the factual false statements. Moral judgment scores were regressed onto variables representing Veracity (True = -0.5, False = 0.5), Statement Type (Factual = -0.5, Religious = 0.5), and their interaction. The main effect of Statement Type was estimated to be -0.13 (95% CI [-0.35, 0.09], $F(1, 19.96) = 1.15, p = .30$). The main effect of Veracity was estimated to be 3.18 (95% CI [2.96, 3.40], $F(1, 19.96) = 722.30, p < .001$), and the Statement Type x Veracity

interaction was estimated to be 2.46 (95% CI [2.02, 2.90], $F(1, 19.96) = 107.94, p < .001$)⁷. As displayed in Figure 8.1, the Religious False statements were perceived to be more immoral than the Factual False statements (mean difference = 1.10, 95% CI [0.79, 1.42], $t(18.55) = 6.60, p < .001$), and the Religious True statements were perceived to be more moral than Factual True statements (mean difference = 1.36, 95% CI [1.05, 1.67], $t(18.79) = 8.09, p < .001$).

Descriptive statistics and zero-order correlations among all individual difference measures are displayed in Table 8.2. I next entered each of these individual difference variables (and participant sex) into separate regression models along with Veracity and Statement Type to examine any moderating effects. There were no reliable 3-way interactions with sex, fairness, loyalty, authority, or moral disgust sensitivity, but 3-way interactions with the following variables were observed: religiosity ($\gamma = 1.09$, 95% CI [0.76, 1.41], $F(1, 722.25) = 43.58, p < .001$), political identity ($\gamma = 0.25$, 95% CI [0.08, 0.42], $F(1, 721.01) = 8.43, p < .001$), harm ($\gamma = 0.81$, 95% CI [0.41, 1.22], $F(1, 703.02) = 15.50, p < .001$), purity ($\gamma = 0.80$, 95% CI [0.47, 1.14], $F(1, 704.15) = 22.08, p < .001$), physical disgust sensitivity ($\gamma = -0.52$, 95% CI [-0.74, -0.31], $F(1, 723.83) = 22.14, p < .001$), and sexual disgust sensitivity ($\gamma = 0.68$, 95% CI [0.37, 1.00], $F(1, 721.17) = 18.50, p < .001$).

Disgust. Next I investigated whether the religious false statements elicited more self-reported disgust than the factual false statements. As above, disgust scores were regressed onto variables representing Veracity, Statement Type, and their interaction. The main effect of Statement Type was estimated to be 1.28 (95% CI [0.97, 1.59], $F(1, 19.97) = 59.67, p < .001$), indicating that the Religious statements elicited more disgust than the Factual statements overall. The main effect of Veracity was estimated to be 1.96 (95% CI [1.64, 2.27], $F(1, 19.98) = 138.64$,

⁷ The main effect of Veracity ($\beta = 0.61$, 95% CI [0.58, 0.64], $F(1, 30.86) = 1775.93, p < .001$) and the Statement Type x Veracity interaction ($\beta = 0.52$, 95% CI [0.46, 0.60], $F(1, 30.82) = 320.44, p < .001$) were also statistically significant when Veracity was entered as a (mean-centered) continuous variable.

$p < .001$), indicating that the False statements elicited more disgust than the True statements overall. As expected, these main effects were qualified by a Statement Type x Veracity interaction ($\gamma = 2.68$, 95% CI [2.05, 3.31], $F(1, 19.98) = 65.01$, $p < .001$)⁸. As seen in the left side of Figure 8.2, this interaction was driven primarily by the Religious False statements eliciting more self-reported disgust than the Factual False statements (mean difference = 2.63, 95% CI [2.18, 3.07], $t(19.25) = 11.18$, $p < .001$). Figure 8.2 also displays the estimated mean emotional experience by Statement Type and Veracity for self-reported anger, fear, sadness, surprise, and happiness.

I next entered each of the individual difference variables (and participant sex) into separate regression models along with Veracity and Statement Type to examine any moderating effects. There were no reliable 3-way interactions with sex, political identity, loyalty, authority, or physical disgust sensitivity, but 3-way interactions with the following variables were observed: religiosity ($\gamma = 0.65$, 95% CI [0.23, 1.06], $F(1, 720.66) = 9.23$, $p < .01$), harm ($\gamma = 0.70$, 95% CI [0.18, 1.22], $F(1, 701.71) = 7.03$, $p < .01$), fairness ($\gamma = 0.73$, 95% CI [0.11, 1.36], $F(1, 701.63) = 5.22$, $p < .05$), purity ($\gamma = 0.46$, 95% CI [0.02, 0.89], $F(1, 702.05) = 4.24$, $p < .05$), sexual disgust sensitivity ($\gamma = 0.95$, 95% CI [0.57, 1.34], $F(1, 720.37) = 23.25$, $p < .001$), and moral disgust sensitivity ($\gamma = 0.42$, 95% CI [0.10, 0.75], $F(1, 720.74) = 6.46$, $p < .05$).

Predicting Moral Judgments. The final question was whether self-reported disgust predicted more harsh moral judgment, and if this effect would remain even after controlling for other emotional experiences. When moral judgment scores were regressed onto self-reported disgust alone the effect was estimated to be 0.20 (95% CI [0.13, 0.27], $F(1, 63.59) = 31.43$, $p <$

⁸ The main effects of Statement Type ($\gamma = 1.34$, 95% CI [1.08, 1.61], $F(1, 20.07) = 95.10$, $p < .001$), Veracity ($\gamma = 0.35$, 95% CI [0.31, 0.40], $F(1, 33.10) = 226.32$, $p < .001$), and the Statement Type x Veracity interaction ($\gamma = 0.54$, 95% CI [0.45, 0.62], $F(1, 32.85) = 129.11$, $p < .001$) were also statistically significant when Veracity was entered as a (mean-centered) continuous variable.

.001). When simultaneously controlling for the effects of anger, fear, sadness, surprise, and happiness, the effect of disgust was estimated to be 0.14 (95% CI [0.06, 0.22], $F(1, 117.48) = 10.24, p < .01$). The estimated effects of the other emotions in this model were as follows: anger $\gamma = 0.07$ (95% CI [-0.0008, 0.14], $F(1, 683.22) = 3.72, p = .05$), fear $\gamma = -0.01$ (95% CI [-0.07, 0.04], $F(1, 610.21) = 0.21, p = .65$), sadness $\gamma = 0.04$ (95% CI [-0.02, 0.11], $F(1, 479.84) = 1.75, p = .19$), surprise $\gamma = 0.02$ (95% CI [-0.03, 0.06], $F(1, 656.64) = 0.47, p = .50$), happiness $\gamma = -0.21$ (95% CI [-0.26, -0.17], $F(1, 567.24) = 83.64, p < .001$).

I next investigated whether the disgust slope varied by the individual difference measures by entering their main effects and interactions with disgust. There were no main effects or interactions with participant's sex, concerns for harm, fairness, loyalty, or authority, nor physical disgust sensitivity, sexual disgust sensitivity, or moral disgust sensitivity. The Disgust x Religiosity interaction was estimated to be 0.09 (95% CI [0.02, 0.17], $F(1, 31.46) = 7.81, p < .01$), the Disgust x Political Identity interaction was estimated to be .05 (95% CI [0.02, 0.08], $F(1, 27.06) = 10.96, p < .01$), and the Disgust x Purity interaction was estimated to be .07 (95% CI [0.005, 0.13], $F(1, 27.22) = 4.45, p < .05$).

Muscle Activity

Levator Labii. I next investigated the primary question of how much levator labii muscle activity changed in response to participants reading religious false statements, and also the extent to which levator labii muscle activity was associated with self-reported feelings of disgust and moral judgment. Change in levator labii activity in response to religious false statements was estimated to be -.00004 (95% CI [-0.0005, 0.0004], $t(26.79) = -0.17, p = .86$), and across the twenty-four statements mean change in levator labii activity was not associated with any of the self-reported emotional experiences nor moral judgments (see lower diagonal of

Table 8.3). As seen in Figure 8.3, change in levator labii activity in response to the religious false statements remained relatively constant across the six second interval. Notably, the strongest change in levator labii activity appeared to be in response to the factual false statements, especially during the first three seconds of the six second interval. Because of this pattern, I also explored the correlation of levator labii muscle activity during the first three seconds of the interval with self-reported emotional experience, but again this analysis revealed no statistically significant correlations (see upper diagonal of Table 8.3). I next regressed levator labii change scores onto variables representing Veracity (True = -0.5, False = 0.5), Statement Type (Factual = -0.5, Religious = 0.5), and their interaction. The main effect of Veracity was estimated to be 0.0007 (95% CI [0.0002, 0.0012], $F(1, 19.93) = 6.25, p < .05$). The main effect of Statement Type was estimated to be -0.0008 (95% CI [-0.001, -0.0003], $F(1, 19.92) = 8.08, p < .05$). The Veracity x Statement Type interaction was estimated to be -0.0013 (95% CI [-0.0023, -0.0002], $F(1, 19.92) = 5.21, p < .05$; see Figure 8.4). The only stimulus that reliably elicited a change in levator labii muscle activity greater than zero was the factual false statements ($\gamma = 0.0014$, 95% CI [0.0007, 0.0020], $t(24.25) = 4.06, p < .001$).

Corrugator Supercilii. Finally I investigated the extent to which corrugator supercilii muscle activity changed in response to participants reading religious false statements, and also the extent to which corrugator supercilii muscle activity was associated with self-reported feelings of disgust and moral judgment. Change in corrugator supercilii activity in response to religious false statements was estimated to be 0.0005 (95% CI [-0.00004, 0.0010], $t(777.5) = 1.81, p = .07$), and across the twenty-four statements mean change in corrugator supercilii activity was positively associated with more harsh moral judgments, and negatively associated with happiness (see lower diagonal of Table 8.3). Mean change in corrugator supercilii activity

was also marginally positively associated with self-reported disgust, anger, fear, sadness, and surprise. As seen in Figure 8.5, change in corrugator supercilii activity in response to the religious false statements was strongest during the first three seconds of the six second interval. Because of this pattern, I also explored the correlation of corrugator supercilii muscle activity during the first three seconds of the interval with self-reported emotional experience and moral judgment. This analysis revealed even stronger correlations with moral judgment and all self-reported emotions (see upper diagonal of Table 8.3). Change in corrugator supercilii activity during the first three seconds in response to religious false statements was estimated to be 0.0007 (95% CI [0.0002, 0.0012], $t(776.6) = 2.75$, $p = .006$). I next regressed corrugator supercilii change scores onto variables representing Veracity, Statement Type, and their interaction. The main effect of Veracity was estimated to be 0.0004 (95% CI [-0.0003, 0.001], $F(1, 19.92) = 1.21$, $p = .28$), indicating no differences between True and False statements overall. The main effect of Statement Type was estimated to be -0.000009 (95% CI [-0.0003, 0.0004], $F(1, 19.92) = .001$, $p = .98$), indicating no difference between Factual and Religious statements overall. The Veracity x Statement Type interaction was estimated to be 0.0010 (95% CI [-0.0004, 0.0023], $F(1, 19.92) = 2.00$, $p = .17^9$; see Figure 8.6). In sum, the only reliable change in corrugator supercilii facial muscle activity was in response to the Religious False statements during the first three seconds of the six second interval. The estimated change in corrugator supercilii muscle activity in response to factual false statements was 0.00003 (95% CI [-0.0007, 0.0008], $t(777.5) = 0.07$, $p = .94$), indicating that corrugator supercilii was not elicited in response to the Factually False statements.

⁹ When analyzing only change in corrugator supercilii activity during the first 3 seconds of the 6 second interval, the Veracity x Statement Type interaction was estimated to be 0.0011 (95% CI [-0.0001, 0.0024], $F(1, 19.92) = 3.08$, $p = .09$).

Discussion

Self-reported emotional experiences replicated the findings of Studies 1 and 2.

Participants found the religious false statements to be more immoral and elicit more disgust than the factual false statements. Disgust also emerged, along with happiness, as a statistically significant predictor of moral judgments when controlling for other negative emotional experiences. Thus across three studies (1, 2, & 4) only disgust and happiness were reliably associated with moral judgments. Anger did not emerge as a significant predictor of moral judgments in this study after controlling for disgust, suggesting that perceptions of immorality in the domain of thought violations are uniquely associated with feelings of contamination. Religiosity again emerged as a reliable moderator of these effects, consistent with the idea that relatively more religious participants are more strongly influenced by cultural beliefs that thought violations are contaminating and immoral. Concerns for purity also consistently moderated the Statement Type x Veracity interactions on moral judgments and self-reported disgust. Of note, concerns for purity were also positively correlated with both sexual and moral disgust sensitivity, but not physical disgust sensitivity. This suggests that the purity moral foundation is associated with a heightened concern for how one's actions reflect on their moral character rather than their physical body (i.e., stepping in dog poop does not speak to one's moral character, whereas sexual promiscuity and theft are probably perceived as better indicators).

Analyses of facial muscle activity were much more revealing. Inconsistent with evidence for the oral origins of moral disgust, thought violations were not at all associated with levator labii muscle activity. Instead, thought violations were more strongly associated with corrugator supercilii muscle activity, which in turn was associated with self-reported negative affect

(including disgust) and more harsh moral judgments. Moral judgments were made after hearing the statements a second time, and so facial muscle activity upon first exposure to the idea was sensitive enough to predict moral judgments made several minutes later. The finding that factual false statements (e.g., “the earth is flat”) were associated with levator labii activity was unexpected. Levator labii muscle activity was not correlated with any of the measured self-reported emotional experiences (surprise was the only emotion with a positive association), making this pattern of results difficult to interpret. At the very least these results provide grounds to question the assumption that levator labii muscle activity is a reliable window into people’s experience of disgust in all contexts. During debriefing several participants reported experiencing “confusion” when considering the factually false statements. One possibility, then, is that levator labii facial muscle activity is associated with a confused expression. This question will need to be addressed in future research by allowing free-responses or by providing additional response options beyond basic emotions. But taking the self-report and facial muscle activity data together, an important conclusion is that moral disgust—at least in the context of perceived religious thought violations—is not associated with the same facial muscle activity as prototypically physically disgusting stimuli. Thought violations appear to be metaphorically disgusting but not literally disgusting (Royzman & Sabini, 2001). What thought violations and feces do have in common, however, is the subjective feeling of contamination. When participants in the present study reported that religious false are disgusting, a reasonable explanation is that they are communicating perceived contamination. However there is no evidence to suggest that this feeling is accompanied by oral inhibition that is typically associated with physical disgust elicitors. The present study further suggests that moral disgust is a unique emotional experience, characterized by feelings of contamination, that is not just a synonym for

anger or reducible to general negative affect. By demonstrating that self-reported disgust is uniquely associated with the morality of mind, and that it is *not* associated with levator labii muscle activity, these data are more consistent with a cultural origin of moral disgust as opposed to the “oral origins of moral disgust” (Chapman et al., 2009).

Chapter 8 Tables and Figures

Table 8.1. Mean moral judgment (Mean), standard deviation (SD), and number of observations (N) for each statement in Study 4.

Factual Statements	<i>Statement perceived as...</i>					
	True			False		
	<i>Mean</i>	<i>SD</i>	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>N</i>
Penguins live in Antarctica.	2.94	1.09	34	-	-	-
Water freezes at 32 degrees Fahrenheit.	3.14	0.99	33	-	-	-
The Earth orbits around the sun.	3.00	1.20	31	-	-	-
There are 12 months in a calendar year.	2.95	1.09	34	-	-	-
The earth's moon is made out of cheese.	-	-	-	4.95	1.07	34
Canada is located south of the United States.	-	-	-	4.91	0.89	33
There are 13 letters in the English alphabet.	-	-	-	5.09	1.02	34
The earth is flat.	-	-	-	4.89	0.95	34
Religious Statements						
God is love.	1.46	0.59	34	-	-	-
Religious faith is a virtue.	1.86	1.01	31	-	-	-
Jesus is the way, the truth, and the life.	1.54	0.51	34	-	-	-
Humans were created in God's image.	1.80	0.84	33	-	-	-
God has a plan for everyone.	1.53	0.61	33	-	-	-
Jesus is the savior of all humanity.	1.58	0.89	34	-	-	-
People have souls that live on after physical death.	1.84	0.86	33	-	-	-
The Bible is the word of God.	1.60	0.85	32	-	-	-
God is a complete myth.	-	-	-	6.30	1.16	34
Praying to God is a waste of time.	-	-	-	6.29	0.70	35
There is no such thing as a soul or afterlife.	-	-	-	6.12	0.89	33
It is silly to trust in God.	-	-	-	6.19	0.89	35
Islam is the true religion of God.	-	-	-	5.00	1.08	30
Religion is just another way to control gullible people.	-	-	-	6.34	0.76	35
Religion is harmful to society.	-	-	-	6.00	1.08	35
Jesus was just a normal man, not the son of God.	-	-	-	6.23	0.80	31

Table 8.2. Means (mean), standard deviations (SD), and zero-order correlations among individual difference measures in Study 4.

	<i>Mean</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9	10
Religiosity	5.79	0.83	-									
Political	3.82	1.60	.39*	-								
Harm	4.97	0.68	.07	-.28	-							
Fairness	4.57	0.57	-.19	-.21	.55**	-						
Loyalty	4.24	0.59	.13	.25	.19	.14	-					
Authority	4.17	0.59	.18	.27	.08	.14	.32†	-				
Purity	4.06	0.82	.15	.27	.46**	.14	.19	.44**	-			
Microbes	4.87	1.26	-.30†	-.45**	.12	.36*	.11	.10	-.14	-		
Mating	5.27	0.89	.17	.18	.25	.16	.19	.34†	.53**	-.05	-	
Morality	5.31	1.07	.26	.17	.24	.10	-.08	.32†	.39*	.06	.18	-

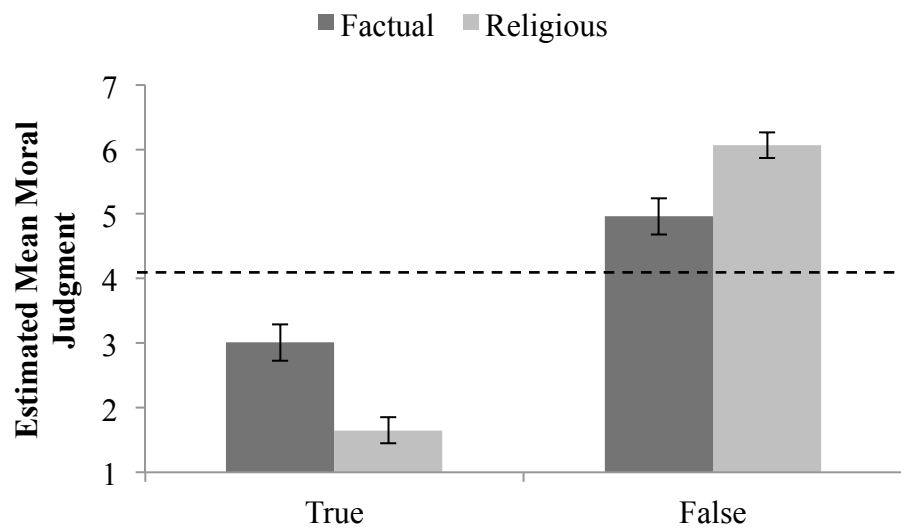
Note. † $p < .10$, * $p < .05$, ** $p < .01$. Religiosity was measured on a scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Political identity was measured on a scale ranging from 1 (*strongly liberal*) to 7 (*strongly conservative*). The five moral foundations sub-scales were measured on scales ranging from 0 (*not at all relevant/strongly disagree*) to 5 (*extremely relevant/strongly agree*). The three disgust sensitivity sub-scales were measured on scales ranging from 0 (*not at all disgusting*) to 6 (*extremely disgusting*). For each participant, the mean of each variable was computed and so values represent correlations across the 35 participants.

Table 8.3. Zero order correlations between mean change in muscle activity, mean moral judgments, and mean self-reported emotional experience.

	1	2	3	4	5	6	7	8	9
Levator Labii	-	-.11	.16	-.18	-.20	-.23	-.25	.21	-.09
Corrugator Supercilii	.05	-	.55**	.51*	.50*	.54**	.53**	.53**	-.62**
Moral Judgment	.17	.41*	-						
Disgust	-.16	.35†	.88**	-					
Anger	-.19	.36†	.85**	1.0**	-				
Fear	-.16	.39†	.54**	.75**	.75**	-			
Sadness	-.22	.37†	.82**	.98**	.98**	.85**	-		
Surprise	.22	.40†	.90**	.77**	.75**	.49*	.69**	-	
Happiness	-.09	-.49*	-.92**	-.73**	-.71**	-.38†	-.67**	-.80**	-

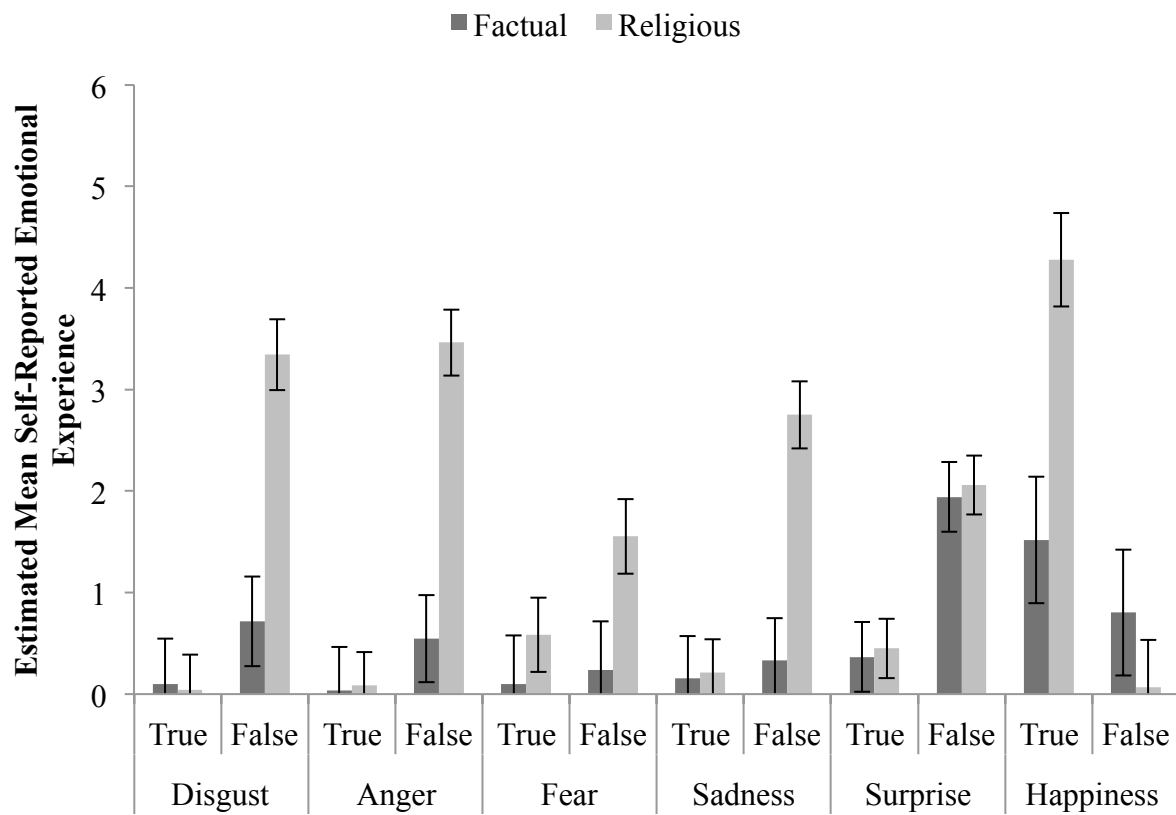
Note. † $p < .10$, * $p < .05$, ** $p < .01$. Correlations with muscle activity during full 6 second interval are in lower diagonal. Correlations with muscle activity for 0 to 3 second interval are in upper diagonal. For each statement, the mean of each variable was computed and so values represent correlations across the 24 statements.

Figure 8.1. Estimated mean moral judgment by Statement Type (Factual vs. Religious) and Veracity (True vs. False).



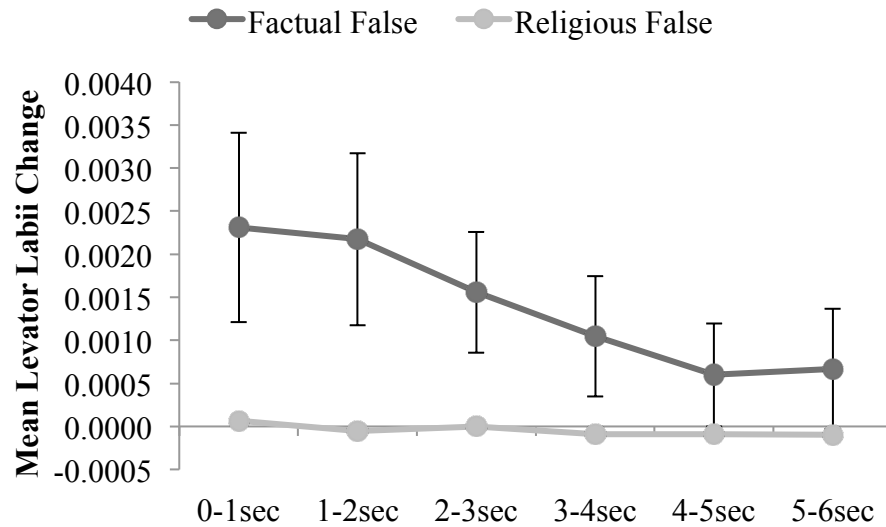
Note. Higher values indicate more harsh moral judgment. Error bars represent 95% confidence intervals.

Figure 8.2. Mean self-reported emotional experience for all emotions by Statement Type (Factual vs. Religious) and Veracity (True vs. False).



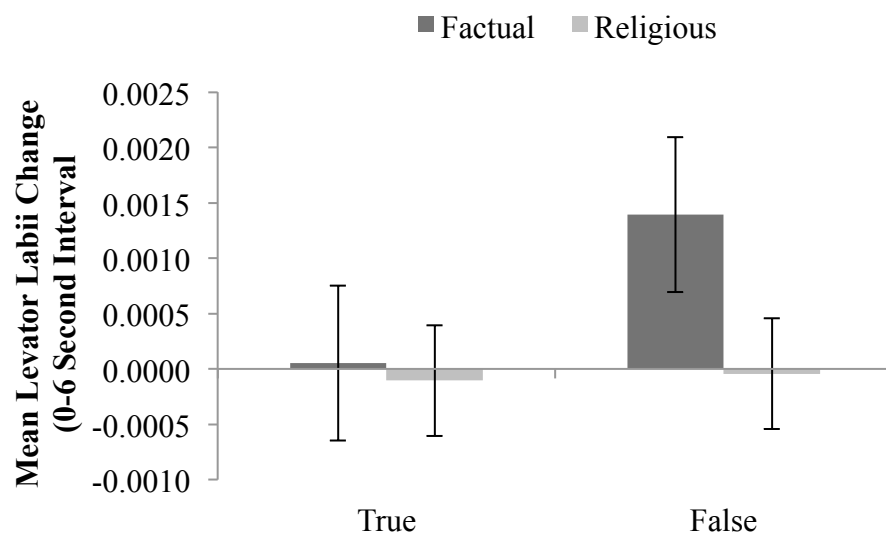
Note. Error bars represent 95% confidence intervals.

Figure 8.3. Mean change in levator labii muscle activity in response to Religious False and Factual False statements for each one second period during the six second interval.



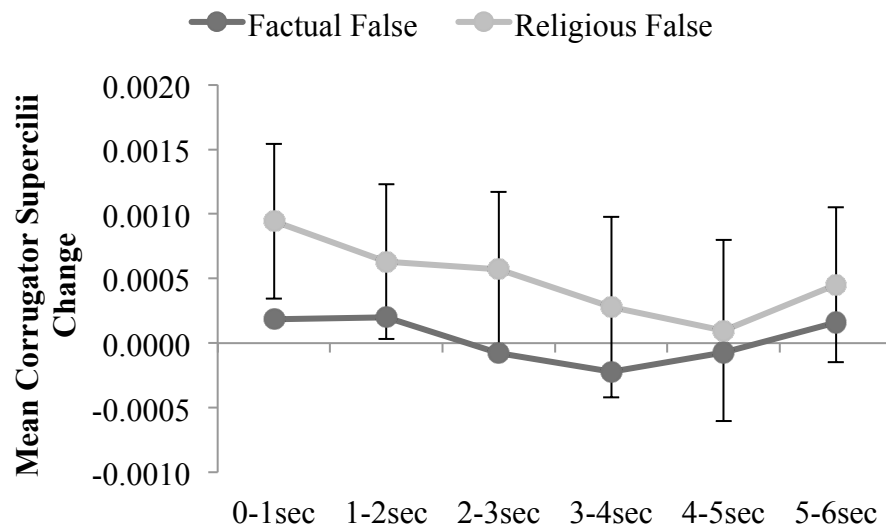
Note. Error bars represent 95% confidence intervals.

Figure 8.4. Mean change in levator labii muscle activity by Statement Type (Factual vs. Religious) and Veracity (True vs. False).



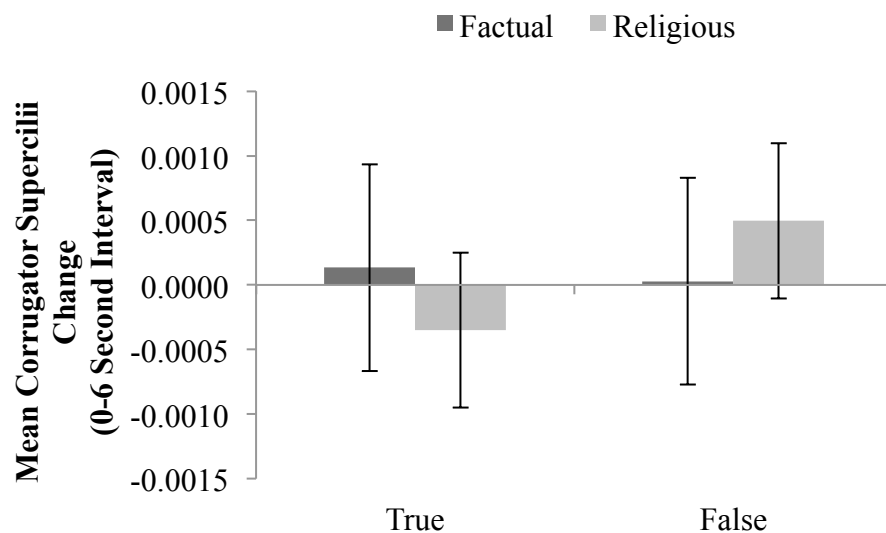
Note. Error bars represent 95% confidence intervals.

Figure 8.5. Mean change in corrugator supercilii muscle activity in response to Religious False and Factual False statements for each one second period during the six second interval.



Note. Error bars represent 95% confidence intervals.

Figure 8.6. Mean change in corrugator supercilii muscle activity by Statement Type (Factual vs. Religious) and Veracity (True vs. False).



Note. Error bars represent 95% confidence intervals.

CHAPTER 9: GENERAL DISCUSSION

Four studies found support for the hypothesis that mere thoughts and beliefs—not only observable behaviors and concrete objects as emphasized in previous research—are an important domain of morality. In Study 1 religious statements perceived as false were rated as more immoral and elicited more self-reported disgust than factually false statements. Self-reported disgust also consistently predicted subsequent moral judgments, and this effect remained after controlling for the effects of anger and other negative emotions. Study 2 directly replicated these effects, and demonstrated that the association between disgust and morality of mind is partly explained by the unique association between disgust and the subjective feeling of contamination. Studies 3 and 4 used facial electromyography to investigate the physiological correlates of self-reported disgust in the morality of mind. Study 3 replicated previous research demonstrating an association between levator labii muscle activity (which wrinkles the nose and raises the upper lip, consistent with an oral/nasal inhibition response) and physically disgusting behaviors (e.g., eating in the same place you go to the bathroom). However, Study 4 found no evidence that religious thought violations are associated with levator labii muscle activity, although measures of self-reported disgust replicated the findings of Studies 1 and 2. Instead thought violations were more strongly associated with corrugator supercilii muscle activity, which was associated more generally with self-reported negative affect (including disgust). The degree of corrugator supercilii muscle activity was also able to predict subsequent moral judgments, whereas levator labii activity was not reliably associated with any measures of emotion or moral judgment.

The most important theoretical contribution of the present research is that it provides evidence that moral disgust is a distinct emotional experience from physical disgust (Marzillier & Davey, 2004; Simpson et al., 2006). Influential theories have argued that certain moral

violations trigger the same disgust mechanism and its corresponding outputs (e.g., physiology, behavior, and facial expression) that have remained relatively unchanged throughout evolutionary history (Chapman & Anderson, 2013; Rozin et al., 1999, 2008; Tybur et al., 2009). In other words, they argue that the elicitors of an innate disgust mechanism have expanded, but the disgust mechanism itself has remained the same. The finding that being treated unfairly in an economic game elicits levator labii facial muscle activity (i.e., a prototypical disgust expression) has been taken to support the “oral origins of moral disgust” (Chapman et al., 2009). However in the present studies people reported feelings of disgust and contamination in response to thought violations, and these subjective feelings uniquely predicted moral judgments, but there was no evidence of an innate oral/nasal inhibition response being triggered. One possible explanation of these findings is that moral disgust is in fact not “the same” as physical disgust. Instead the present studies better support the hypothesis that self-reports of disgust in response to thought violations are being used metaphorically to communicate the subjective experience of cognitive contamination, rather than literal oral inhibition or moral dyspepsia (Royzman & Kurzban, 2011).

Of course there are alternative interpretations of these findings. If disgust and anger are in fact evolved innate psychological mechanisms, then it makes sense to assume their discreteness and “control” for anger to examine the pure influence of disgust. But the high correlation between disgust and anger might also suggest a fundamentally different association between emotions and morality (for a review, see Cameron et al., under review). Although anger and disgust can be reliably differentiated using prototypically harmful and physically contaminating behaviors, respectfully (Study 3; see also, Niedenthal et al., 2009), it is clear that they are co-activated in response to thought violations (and non-bodily moral violations more

generally; Russell & Giner-Sorolla, 2013). Disgust and anger were strongly co-activated across all three relevant studies (Study 1 $r = .88$; Study 2 $r = .78$; Study 4 mean within-subjects $r = .87$, $SD = .11$; see also, Marzillier & Davey, 2004; Simpson et al., 2006). Facial electromyography in Study 4 further demonstrated that thought violations were associated with general negative affect as measured by corrugator supercilii activity (Cacioppo et al., 2000), and both disgust and anger were correlated with muscle activity in this region. From a constructionist perspective this high correlation between disgust and anger points to the conclusion that these emotions are not discrete “natural kinds” after all (Barrett, 2006a). Instead responses to thought violations are better explained by the fact that both anger and disgust share in common an underlying negative and physiologically arousing affective state. Thus what remains of disgust after “controlling” for anger (i.e., after partialling out the variance these two emotions share from being negative and physiologically arousing) is conceptual knowledge about contamination (Cameron et al., under review). From this perspective, the conclusion is that conceptualizations of core affect as contaminating play a central role in the morality of mind. Self-reported disgust (along with happiness) consistently predicted subsequent moral judgments after statistically controlling for other emotions. Anger did not. Thus moral disgust cannot be reduced to feelings of anger (cf. Gutierrez et al., 2012; Nabi, 2002), at least in part because it is uniquely characterized by the subject feeling of cognitive contamination.

These findings complement and extend previous research related to the morality of mind (Ritter & Preston, 2011; Tetlock et al., 2000). Whereas my previous work asked participants to hand-copy either an ingroup or outgroup (or control) religious passage and found evidence of increased disgust after copying the outgroup religious passage only (Ritter & Preston, 2011), the present studies demonstrate that *mere contemplation* (Tetlock et al., 2000) is sufficient to elicit

disgust. Simply considering some ideas in the mind for only a few seconds elicited feelings of cognitive contamination. And although previous research has also demonstrated this effect (Tetlock et al., 2000), the present research underscores disgust as the important predictor of moral judgments in the morality of mind as opposed to undifferentiated moral outrage (disgust, anger, and contempt). The present findings are also consistent with Tetlock and colleagues' (2000) sacred value protection model, insofar as religious statements perceived as false but not factually false statements elicited feelings of cognitive contamination. Previous research has not made this distinction, and instead focused on the rejection of falsity more generally (Harris et al., 2009; Harris et al., 2008; Gilbert, Krull, & Malone, 1990; Gilbert, Tafarodi, & Malone, 1993). This is consistent with the idea that religious ideas are consistently *moralized* (Rozin, 2001); they are not mere preferences, but sacred values that foster ingroup solidarity (Graham & Haidt, 2010), signal the content of one's moral character (e.g., trustworthiness; Gervais et al., 2011), and are perceived to have drastic moral consequences for the afterlife. Indeed religiosity moderated the effects of moral judgment, disgust, and contamination across all the studies presented here, suggesting that the more strongly people are involved in their religious culture the more they perceive ideological threats to ingroup sacred values as cognitively contaminating.

All research has limitations, and the present studies are certainly no exception. These studies focused on only six emotional experiences (anger, disgust, fear, sadness, surprise, and happiness), but of course other unmeasured emotions could be equally or more important than disgust. Candidates include contempt which is predicted to be associated with looking down on and feeling morally superior to others (Ekman, 1994b), incompetence (Hutcherson & Gross, 2011), or failing to carry out duties within a community (Rozin et al., 1999). Self-conscious moral emotions (e.g., guilt, shame, and embarrassment; Haidt, 2003) were also not investigated

here. Future research could include additional emotions as response options, or use free recall to provide a more rigorous test of the role of disgust in the morality of mind. This research is also not the definitive word on the metaphorical vs. oral origins of moral disgust. Although disgust's unique facial expression provides some of the best evidence for its status as a basic discrete emotion (Keltner & Ekman, 2000), the present studies did not find evidence of the prototypical disgust expression in response to religious thought violations. This was in spite of self-reported disgust emerging as an important predictor of moral judgments. It is possible that this null finding is due to methodological limitations. Subjectively, disgust is associated with a distinct bodily sensation (Nummenmaa, Glerean, Hari, & Hietanen, 2014). Thus perhaps some other method besides facial electromyography is better suited to detect the manifestation of disgust as an innate and discrete psychological mechanism, although previous efforts to find such a unique signal of disgust have proven elusive (Cacioppo et al., 2000). Given the communicative power of emotional expressions, another possibility is that the lack of a meaningful social context (e.g., participants were not explicitly asked to pose their facial expressions for others to see; Gilbert, Fridlund, & Sabini, 1987) resulted in the suppression of a physical disgust expression. Although participants experienced contamination there may have been no need to express it on the face because there was nobody else to communicate it to. Future research could address this possibility, but this explanation is unlikely because participants' facial muscles were still active in response to perceived thought violations (i.e., corrugator supercilii muscle activity) suggesting that the null finding on levator labii muscle activity cannot be explained by general inactivity. Moreover, previous research has found facial EMG effects in the absence of social context (e.g., Cannon et al., 2009), especially when participants are asked to make judgments about emotional experiences as in the present studies (Niedenthal et al., 2009). A final word of caution is in order

regarding the generalizability of the present findings due to sample limitations. Although Studies 1 and 2 used relatively diverse samples of United States participants using Amazona's Mechanical Turk (Buhrmester, Kwang, & Gosling, 2011), the facial EMG studies were limited to (mostly women) Christian college undergraduate students. Thus an important area of future research will be to examine whether the findings presented here are robust across demographic variations including age, sex, and religious affiliation. The role of religious affiliation could prove to be particularly important, as previous researchers have found cultural differences in the extent to which people moralize the content of others mind (Cohen & Rozin, 2001; Kim et al., 2013). Even in the larger MTurk samples, religious affiliations other than Christianity and Atheism/Agnosticism were not well represented (e.g., Judaism, Islam, Hinduism, Buddhism). It is thus an important yet unanswered question as to whether people from these other religious groups respond to threats to sacred ingroup values with disgust and feelings of cognitive contamination. Insofar as these religious traditions emphasize spiritual cleanliness and the moral consequences of beliefs, I suspect that the disgust in the morality of mind is robust across religious boundaries.

Conclusion

This research set out to address two questions: (1) are religious thought violations associated with disgust/contamination?; and (2) when people use the word “disgust” to describe how they're feeling in response to religious thought violations, does this mean they are literally experiencing oral/nasal inhibition? These questions are important because previous research has focused almost exclusively on the association between disgust and immoral behaviors, making it unclear whether abstract thoughts—independent of overt action—can be perceived as disgusting/contaminating. Moreover, there is still considerable debate about the nature of moral

disgust in response to violations that do not involve physical contamination. Although religious people consistently reported that blasphemous thoughts were disgusting (and self-reported disgust consistently predicted moral judgments over and above other negative emotional experiences such as anger), there was no evidence that religious thought violations literally made people feel nauseous or elicited a physical state of oral/nasal inhibition. Instead the evidence better supports the idea that religious cultures draw heavily from conceptual knowledge about contamination to give concrete meaning to abstract concepts about immorality (i.e., virtuous thoughts are “clean” and sinful thoughts are “dirty”). Blasphemous thoughts may be perceived as disgusting/contaminating, but only metaphorically so.

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APPENDIX

Statements used in Study 3.

Purity Vice

Drinking a glass of warm, spoiled milk.
Stepping barefoot into a pile of dog poop.
Sitting next to a stranger with bad body odor.
Smelling a stranger's awful morning breath.
Eating rotten meat.
Eating in a dirty public bathroom.
Sitting next to a stranger with an open wound.
Seeing mold on old leftovers in your refrigerator.
Finding a long hair in your bowl of soup.
Watching someone else throw up.

Purity Virtue

Eating healthy food.
Keeping a clean house.
Exercising to stay healthy.
Brushing your teeth after every meal.
Meditating to keep your mind free of impure thoughts.

Harm Vice

Someone rudely cutting in front of you in line.
Someone kicking your pet dog.
Someone punching you after you accidentally bumped into them.
Witnessing someone steal a purse from a blind person.
Someone making fun of you and hurting your feelings.
Witnessing someone kill an endangered animal.
Witnessing someone make cruel remarks to an overweight person.
Someone threatening to physically harm you.
Someone lying to you to get what they want.
Another driver cutting you off on the freeway.

Harm Virtue

Donating money to a charity to help fight hunger.
Stopping to help someone fix a flat tire.
Helping someone who has suffered emotionally.
Showing compassion to those in need.
Volunteering at a soup kitchen.